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A box car being dismantled with great care to damage no parts

Out-door sawmill where wood from old cars is made over

Saving Freight Cars from the Bonfire

By R. P. Crawford

WHENEVER a railroad found a few old, worn-out freight cars standing on its sidings, it was the custom to summon the steam derrick, haul the cars out to an isolated spot, lift the bodies off the trucks and cast them to one side of the track. They were then set on fire and later the metal parts were picked up among the ashes. That was a quick and easy way of getting rid of them. There are many roads that still follow this plan; but at least one has found that these old, apparently worthless car bodies are worth money and has set out to utilize them.

So whenever a car is found to be no longer capable of efficient service it is sidetracked at one of the division points and there awaits the workmen's pleasure. Each car is carefully dismantled. Pains are taken that the wooden siding and roofing are damaged as little as possible. The usable portions of the cars are then cut up and made into siding or roofing for other cars, running boards for the tops of closed cars, or the coal doors that are used to hold coal in a box car in case the outer door is opened. Thousands of the latter are now made at a cost of a few cents apiece or only a fraction of what was formerly paid for them. Corner posts are salvaged and used in other cars. Even crooked bolts are straightened in a special machine and used again. The trucks from many of the smaller freight cars are employed on stock cars. And finally, fragments of wood in such condition that they are good for no specific purpose find a use as kindling wood in starting locomotive fires. Even wrecked cars that formerly were burned are now salvaged in the same way.

A type of car, discarded from service, which yields much good wood and metal

It has been found that thousands of dollars may be saved every year in this manner, even often charging the job with the time spent in tearing down the cars. Some idea of the tremendous number that would ordinarily have been burned may be judged from the fact that 400 such condemned cars accumulated in the yards at Lincoln, Neb., at one time last year. With the growth in size of freight cars in recent years every road has found hundreds of the cars of former days on its hands. While all railroads have endeavored to save the metal parts, the conservation of the wood waste represents another step in the final sorting over and saving of every bit of second-hand material.

An interesting and accurate system has been devised to determine whether or not a car should be torn down. Obviously it would be unwise to set out to tear down all cars built in a certain year or of a certain size without regard to usefulness, or to depend merely on the superficial judgment of an employee. Freight cars are divided into various classes and sizes. For instance one division is into twenty-ton, twenty-five-, thirty- and fifty-ton cars. In each class there is allowed a certain sum for repairs. A critical inspection of each car is made when it comes into the yards and the exact cost of repairs to put the car in running condition is figured. If it is more than the sum allowed, a report is made to headquarters and the car is condemned automatically. Naturally in the case of the oldest cars the limit of expenditure is a very few dollars while in the case of the latest cars the repair allowance is limited only by the cash value of the car when new.

Rearing White Mice for Experimental Use

IT is not very well known that infant foods are often tried out experimentally on baby white mice. In various laboratories throughout the country large numbers of white mice are fed exclusively on infant foods and infant milk modifications. The inference cannot be drawn from this that infant mice and human infants require the same foods; but growth or lack of growth in the mouse does indicate something of the growth-promoting properties of the food used. Large numbers of the baby mice are fed on each food so that the individual differences in the mice may be eliminated. The food is judged by the average growth of all the mice in the group.

The baby mice in the experiments are as hygienically cared for as are real babies. The wire cages in which they are kept are sterilized twice a week. In the bottom of each cage is a white crepe paper napkin to protect the little feet from the wires. A clean napkin is given a least once a day, and often twice or three times. The infant-food mixtures are given from three to five times a day, from little glass dishes resembling individual salt dishes. The dishes are sterlized every time they are used. These aristocratic little pets must have distilled water to drink. This is furnished from a little glass bottle having a stopper with a glass tube, inverted in the top of the cage. A drop always hangs at the end of the glass tube, and when a mouse is thirsty, it climbs up and licks off the drop, when another drop immediately forms. In this way the purity of the water at all times is insured. To be sure, these pets are never bathed, but why should they need it? They have no chance to get dirty.

Each mouse is numbered instead of named, and its number on a card is attached to its cage. When three or four young mice which would be distinguishable, are in one cage, a small bunch of fur is cut from each mouse, at different parts of the body. The place of this bald spot is indicated on the number tag. The cutting must be repeated every two weeks on a normally growing mouse, as the hair soon grows out. Once every three days, or twice a week, or sometimes even every day, according to the specific object of the experiment, each mouse is weighed and its weight recorded. Weight charts are also kept and the weight of each mouse at each weighing is charted, just as your baby's weight record is charted. A mouse three weeks old weighs from eight to eleven grams, or about a third of an ounce. A full-grown mouse may weigh as much as thirty-five grams, or one and a quarter ounces. The mice, like babies brought up by rule, are not allowed to be handled. Even in the weighing, the mouse's body is not touched. The mouse is lifted from its cage to the glass beaker in which it is weighed, by its tail. Sometimes nickel-plated pincers are used, but usually the bare or gloved fingers of the experimenter are found more convenient. As a rule, the mice do not bite. They become accustomed to the weighing, and even seem to await it eagerly. Occasionally a mouse is found with fighting blood, that will bite at any opportunity. If any mouse by chance escapes and is chased and cornered, it will usually try to bite when caught.

The cages are kept on shelves in a well-heated, well-ventilated room. The mice that are being experimented upon form one division. At three weeks of age, the baby mice are taken from their mother, and given the experimental food. They are used through the rapidly-growing period of their lives—about two months. Often they are kept upon the same food all their lives, and even to the third and fourth generation. In another division are kept what are known as the breeders. These get a mixed diet of sunflower seed and dog biscuit, with, now and then, a piece of apple or carrot or lettuce. As a rule, the mice in this division are not weighed, but their cages are as carefully sterlized and their drinking water as thoroughly distilled as the others. Then there is often the hospital division, with its isolation ward. If a mouse has been injured, as they sometimes are by fighting each other, he is placed in the hospital division until he recovers. If, however, a mouse has a contagious disease, as tuberculosis or a skin disease, he is isolated and the experimenter sterilizes his hands and anything with which the quarantined mouse has come in contact, before touching any of the other cages. Every precaution is used to keep the mice in a healthy condition, and to protect them from taking cold.

It has been said, "It used to be thought a small boy's job to feed white mice, but now one needs a college degree to undertake it."

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The object of this journal is to record accurately and lucidly the latest scientific, mechanical and industrial news of the day. As a weekly journal, it is in a position to announce interesting developments before they are published elsewhere.

The Editor is glad to have submitted to him timely articles suitable for these columns, especially when such articles are accompanied by photographs.

A Call for Instant Action

A FEW months after the outbreak of the war we published a series of articles under the caption "Our Country, An Undefended Treasure Land," in which we told the astounding story of our military defenselessness.

We then gave warning that our country, drifting and without a pilot, was already caught on the outer edge of the maelstorm of the European War. That was two years ago; and in the interim we have been drawn, remorselessly, in ever-narrowing circles and with ever-increasing speed, towards the vortex. Today we are about to be swept into the very center of this gigantic conflict.

How far has Congress taken heed of this warning of two full years ago? How far have these two full years of grace been employed in making ready the defenses of our country?

The answer was given a few weeks ago, in a public hearing before a sub-committee of the Committee on Military Affairs of the United States Senate, by Major-General Leonard Wood, in a statement which we publish, in the hope that this tragic recital will awaken Congress to the need for instant action, if the country is not to become the victim of a profound national disaster.

"Our regular organizations," said General Wood, "lack many things which are vitally essential in modern war. We lack machine guns of all types; in fact, we have very few of the best types of modern machine guns, either light or heavy. Such light guns of the best and the most modern types as we have, we have secured from an English contract with an American firm. These guns do not use our ammunition. The hand grenade or bomb plays an important part in modern war; we have nothing approaching an adequate supply even for our present small Regular Army. We are without trench mortars of the type in general use throughout the battlefields of Europe. We are without various kinds of field signal apparatus, especially for night work. We are short of modern field wireless to such an extent that we had to strip Panama in order to secure a small amount for use on the border. We are without any of the modern types of heavy mobile artillery such as is in general use in Europe—artillery which often has had a determining effect upon operations. I refer both to the type which is moved on the ordinary artillery carriage, and to that powerful type which is mounted and moved on a railway carriage. We are dangerously short of reserve rifles and of field artillery; we have not enough field pieces adequately to equip even the Regular Army and militia at war strength, and not a field gun for volunteers. We are inadequately supplied with reserve ammunition. The fact is our supplies are ridiculously small. We have not built in this country as yet any of the modern aeroplane engines of the latest military type. Steps are being taken to correct this deficiency, but it will be a long time before we are moderately prepared in this arm. We are not constructing, as we should, with all possible haste, artillery of various types. We are building little or none of the long-range mid-caliber type of artillery such as is now in general use. We have made no adequate increase in the way of reserves of ammunitions of war since the war began. Indeed we are only just commencing the manufacture of the approved heavy type of machine gun, and have not yet determined the type of light machine gun we are to use, although these guns must be provided in the proportion of about eight of the light to one of the heavy guns. This is the condition, although the world's greatest war is two and one-half years old, and its lessons as to equipment, development of arms and munitions are an open book to all the world. We have not taken the necessary steps to complete immediately the fire control of our sea-coast guns. We are without adequate searchlights and also without anything even approximating a reasonable supply of auto air-craft guns. We are not making effective and rapid strides in the absolutely essential remodeling of the carriages of our major caliber sea-coast guns, a remodeling which will give them elevation absolutely necessary if they are to meet similar guns afloat. Our arsenals for small arms have been working only to a small extent of their capacity. We are without reserves of clothing, shoes or other equipment necessary for war. We have not taken the necessary steps to establish nuclear plants for the manufacturing of our military rifle at the great arms factories in various parts of the country. This is absolutely necessary in order to permit that expansion which will be necessary in order to meet the demands of modern war. Our arsenals are wholly inadequate to meet these demands. This is a fact of common knowledge. Adequate steps have not been taken to acquire the necessary reserves of those things which we do not produce in this country, but which are vitally essential in modern war. We stand practically as unprepared as when the great war began, and are apparently unobservant of its clear lessons and unappreciative of the fact that no amount of money and no amount of effort can purchase time or make good its loss. Whatever the ultimate organizations of our resources may be, there is no question whatever as to the necessity of supplying a sufficiency of the above equipment, arms, and munitions to promptly equip and arm a force of at least two and one-half million volunteers with adequate reserves for a year. Whatever the ultimate organizations of our resources may be, it has been strikingly apparent for two and one-half years that we should immediately prepare in large amounts the absolute essentials of modern war, only a portion of which have been referred to above. We are also very short of reserve officers and practically without reserves of instructed men. Declarations which include, in the list of instructed men, boys who have graduated from so-called military schools, and men who have had short terms of service in the militia, are unworthy of serious consideration, as they indicate entire failure to appreciate the fact that these men are not trained soldiers.

"Our people enthuse over some new form of torpedo or a general discussion of the question of organization of our reserves, but fail to grasp that the deficiencies enumerated above relate to the absolute necessities which it will take a long time to produce. They do not realize that we have not, and cannot secure for many months these absolutely necessary every-day weapons and equipment of war. They fail to appreciate that these must be produced in time of peace and that the organization of all our resources is to keep up the supply once war is upon us. Furthermore, they do not realize that an untutored, untrained, and undisciplined people cannot pick up these weapons and use them effectively; that this preparation also requires time, and that little or nothing is being done, except in preparation for next summer's training camps and through private efforts conducted with private funds. Our safety is dependent upon the forbearance of others and not upon our ability and preparation to defend ourselves."

Industrial Man Power and the War

MODERN warfare makes terrific demands upon the industries of a nation and through them upon its man power. Now and again there is difficulty with some material supply; but from beginning to end the labor question is continuously acute. Artillery and ammunition, food and clothing, automobiles and aeroplanes and ships, engines and machine tools and tool machines, are but a few of the things consumed in unprecedented quantities. Armed forces and industrial units alike must be kept at fullest strength or disaster follows swiftly.

How to do this is the outstanding problem. It is a problem of whose very existence England was sublimely oblivious at first. It is a problem which she had begun to formulate in six months, to grapple with in a year; one whose satisfactory solution she may fairly be stated to have but just now finally worked out; and one which today confronts us as we are dragged nearer to participation in the war.

We must of course avail ourselves of England's experience to the last measure. And this experience is maiply along the lines of common sense. Under ordinary circumstances, when confronted with loss of an employee, the employer has two lines of effort open; he may keep the man or replace him. The same alternative is presented when loss of a large body of workers is threatened through enlistment; we may keep them or we may replace them.

Attention has been centered upon the efforts to replace skilled workers who have gone to the front, for this is a spectacular story with news value. Much has been said of the dilution of skilled labor with unskilled, of the employment of a dozen green workers under the supervision of one or two of the former skilled staff. Even more comment has been lavished upon the assignment of women to tasks always heretofore entrusted to men. But when all is said and done, a substitute is a substitute, and the genuine article is to be preferred.

When a man has reached the age of thirty as an unskilled laborer, it is probable that unskilled labor is the limit of his capacity. He may have been merely unfortunate, he may be capable of development, but the presumption lies against him. In any event he will require some period of schooling before he begins to give satisfaction; and he can hardly be expected to pick up, even in a year or two, all the valuable little points with which long apprenticeship and service have made the qualified journeyman familiar.

If in one respect a woman has an advantage over such a man, in another she is at a disadvantage. No presumption can be asserted against her; on the contrary, there are very many more or less delicate operations at which her small fingers and quick adaptability make it possible for her to develop a degree of speed and accuracy placing her quite beyond the most expert male competition. But in many more places where it would seem that a woman would fit, it turns out that, sometimes in its entirety and sometimes in a single necessary motion out of many, the work demands a physical strength and a measure of endurance which she does not possess. In any event there is the period of schooling; and the one thing which we must at all costs prevent is an initial demoralization of our industries. Woman has done many wonderful things in England; but there are as many more for which she may not be called upon sucessfully.

It is plain then that while we must be prepared to replace many of our industrial workers, there are many whom we must not, and many more whom we should not, replace—whom we must or should keep at their present work. How? We must have no mobs of women waylaying these men on their way to work, with rotten eggs and taunts for the "slackers." It must be plain that between those who are forced or allowed to go out and fight, and those who are allowed or forced to stay home and work, there is no invidious distinction—that all are serving the country in the place where they will count for most.

The answer, of course, is the formation of a definitely organized Industrial Reserve, membership in which carries all the honors of war, including perhaps a uniform, certainly an insignia. This matter is even now in the hands of the Council of National Defence.

On England's showing the organization of such a body requires the gathering of a vast amount of information. Efficiency and fairness alike demand that all men of substantially the same capabilities be called upon for substantially the same contribution to the general fund of man power. The Council is again at work here, ascertaining just what trades and branches of trades should be included in an Industrial Reserve, and in due course this information will be obtainable through the proper channels. But this is only half. Who shall say what men are to be included among the various reserved classifications? Who possesses the uncanny power of going among our forty-odd million adult males and picking out the competent tool-makers, engine builders and engine runners, machinists, telegraphers, and so on through the long list of the Reserve?

Plainly no one man can do this; each citizen must speak for himself, through some recognized agency which possesses authority and carries respect. No more appropriate agency could be found than our state governments. As related in these columns last week, Connecticut has blazed the way, has shown us how to take an accounting of the people, by the people and for the people. Other states are planning to follow this example; let all do so. Let every one of our commonwealths forthwith proceed to count noses, to find out just what each individual can do to help his country in this threatened crisis, to organize this body of information as is being done in the Land of Steady Habits. Then if the worst comes, each state will be in position at the call to arms to say to each one of its citizens "Go" "Stay," as the case may be.

Astronomers and Daylight Saving

The daylight saving plan was recently considered by a committee of the American Astronomical Society, with the result that two of the five members favored the adoption of the plan, one thought it should be put in operation experimentally, and the remaining two believed the disadvantages would distinctly outweigh the advantages, and therefore opposed the plan.

The committee agreed in recommending that, if daylight saving should be adopted, the names now in use to describe standard time should be continued with unchanged meaning. For example, the time used in summer would be called Eastern Time, while that used in winter would retain its present name of Central Time. The committee also noted the fact that the alleged advantages of the plan would be less in the southern part of the country than in the northern, because the hours of daylight are more nearly the same throughout the year in lower latitudes, and hence it would be advisable to modify the plan for the extreme southern portion of the country.

Naval and Military

Improvement in Naval Recruiting.—During 26 recruiting days, up to February 28th of this year, the roster of the navy was increased by 2,086 men, the gain in one single week being, 901 men. This improvement is due in no small degree to the coöperation of the Navy League with the Department. The decrease in the number of men lost by discharge is being more than balanced by new enlistment, and the figures of men in the service on February 28th, namely, 59,037, exceed the forecast made by naval officers in the Department, that on the 1st of March they would have 57,000 men.

Size of the British Navy Personnel.—It has not been made known officially just how many ships have been added to the British navy since the war began, but some idea of its present size is afforded by the official announcement in Parliament, made on February 17th, that 400,000 men were provided for in the financial estimates for 1918. Many thousands of these men, of course, are manning the mine-sweepers, submarine chasers, transports and supply boats, and still other thousands must be held in reserve. A proportionate war-time increase will be necessary in our own Navy.

Shells for the Navy.—The contract which was let by the Navy Department on January 17th to Hadfields, Ltd., for 14-inch and 16-inch projectiles, was invalidated for the reason that the British government, on learning of the contract, prohibited the company from making delivery, at least until the conclusion of the war. This action was taken on the ground that all the military-industrial resources of Great Britain should be reserved for the supply of the military needs of the nation. Subsequently the British Government removed its embargo; but meanwhile the Navy Department had let the contract to American manufacturers.

Retention of Navy Yards Advised.—A special commission of naval officers appointed by President Wilson has recommended that it is unnecessary and inadvisable to abolish at this time any existing navy yard, or naval station, within the continental limits of the United States. The report declares that the present equipment of many yards is inadequate in drydocking facilities, berthing space, storage facilities, machine equipment and in other details. Not only are the yards unequal to the requirements of the fleet, but they would be seriously inadequate when the fleet is completed to its present authorized strength.

Wind Resistance of Ships.—Of late years much attention has been given to the question of the horse-power necessary to overcome the large resistance offered by ships to the atmosphere, particularly when they are steaming fast against a head wind. Naval Constructor William McEntee of the United States Navy, gives in *Marine Engineering* the results of tests made in the wind tunnel at the Washington Navy Yard on a model of the collier "Neptune." Tests show that if the vessel were steaming against a 30-mile wind at 14 knots, it would require about 770 effective horse-power to overcome the wind resistance. This is about 20 per cent of the power necessary to drive the ship through the water. The "Neptune" because of her large number of coaling booms and other top hamper offers an extreme case.

Guns for Merchantmen.—Now that President Wilson has determined to arm our merchant shipping, there will be an immediate demand for guns of from 3- to 6-inch caliber. On the last day of February bids were opened for 2,400 3-inch guns and several thousand one-pounders. The larger and more important ships will probably carry 6-inch guns; in fact, the four mail boats of the American Line have always been ready for the mounting of 6-inch guns, the necessary stiffening having been given to the decks at the points where these guns are to be mounted at the time the ships were built. A 3-inch gun weighs about 2,300 pounds, whereas the latest type of 6-inch naval gun weighs, without its mount, just under 20,000 pounds. For a gun of that weight and power considerable reinforcement of the deck beams is necessary, if the gun is to be held up to its work.

Another Year of War Probable.—The vast scale on which the war has been waged tends to make a quick military decision unlikely. Battles have been fought in this war, any one of which would rank as the greatest in history, but none of which has been able to give more than a temporary check to the vast momentum of the conflict. It is unlikely that the war will be terminated this year by any military successes. If a decision is reached it will be by the economic breakdown of the Central Powers. We note that Gen. Frederick B. Maurice, British Director of Military Operations of the General Staff, is quoted by the Associated Press as saying, "There is no reason to anticipate on purely military grounds, an early collapse of the Germans." Later in the same interview, he remarks, "I have no patience with the idea that the Germans are at the end of their fighting resources. They are still capable of, and will put up a strong fight. From the purely military standpoint, I see no reason why the war should not go through another winter."

Science

Australia Adopts Daylight-Saving.—Under the terms of the daylight-saving law recently passed by the Australian parliament, all clocks throughout the commonwealth will hereafter be put forward one hour at the end of September and put back one hour at the end of March of each year. For the year 1917 the act took effect January 1st.

Gas-meter Provers.—The Bureau of Standards has been studying various types of provers for gas-meters, and is preparing a publication on the subject. Several forms of cubic-foot apparatus, such as are used to calibrate meter provers, have also been investigated, and the bureau has devised a new portable type of cubic-foot apparatus, which can easily be carried about by one man, and should be especially valuable in the State inspection of meter-testing apparatus.

A School of Fisheries will probably be established shortly at the University of Washington. According to Science, Professors Kincaid and E. V. Smith, of the biology department of the university, are already devoting much time to the study and development of the oyster and salmon industries on the Pacific coast. If the stage legislature grants the necessary appropriation, an expert on fishing and fisheries will be added to the staff, and suitable laboratory facilities will be acquired. The university has asked the United States Bureau of Fisheries to have its exploring vessel "Albatross" winter in the fresh waters of Lake Union, which wash one edge of the university campus, in order that the vessel may be utilized as a practical laboratory for professors and students.

Electrical Precipitation of Dust.—The last annual report of the Smithsonian Institution refers to recent progress in the use of the Cottrell process for the precipitation of dust, smoke and chemical fumes by means of electrical currents. In addition to the use of this process in the dissipation of fog, carried on experimentally in California, with the aid of a grant from the Smithsonian Institution and in cooperation with the United States Lighthouse Service, successful commercial installations have been made on the following fumes: Silver fumes form electrolytic slimes of copper refinery; tin fumes from detinning process residues; hydrochloric acid fumes from cleaning vats in electrogalvanizing plant; tin and zinc fumes from waste metal recovery plant; "low bleach" from electrolytic plant; sulphuric acid mist from contact acid plant; lead fumes from copper converters; fumes from roasting of zinc ores; dust from buffing wheels and from machines for powdering slate.

A Novel Optical Phenomenon is described by Mr. H. H. Martin in the *Monthly Weather Review*. On August 6th 1916, at Fort Worth, Texas, the circumzenithal arc (upper quasi-tangent arc of the halo of 46 degrees) was observed for over half an hour, and numerous angular measurements of it were made. For about 4 minutes of this period the arc was seen to be divided longitudinally by a single dark line running the full length of the arc, dividing the latter into two bands, the widths of which were in the ratio of 2 to 3, the narrower band being next the sun. Mr. Martin compares this line to an absorption band in the solar spectrum. Though the circumzenithal arc is a common phenomenon, its division, as above described, appears not to have been previously reported. As the SCIENTIFIC AMERICAN has pointed out from time to time, the study of solar and lunar halos offers excellent opportunities of making interesting discoveries, as the subject has been strikingly neglected except by a few specialists. Interest in this subject has, however, been markedly stimulated of late in the United States.

Seismological Work in the Western United States.—Dr. Harry O. Wood has published in the *Bulletin* of the Seismological Society of America detailed plans for a system of seismological stations in the western United States and drawn up a program of the investigations and practical work which such an organization might undertake. He recalls the fact that in this region, and particularly in California, it has always been the popular custom to belittle the danger of earthquake—even to the extent of suppressing scientific reports made on certain disasters of this character. This policy, which is unknown in other seismic regions of the globe, is due to the fear that publicity given to the facts would check immigration and injure business. Dr. Wood declares that the danger arising from the prevalence of this attitude is far greater, morally, financially and in its menace to human life, than the danger from the physical shock of earthquake, frankly faced and prepared for. The earthquake danger, which generally in the Pacific states is less serious to human life and no more serious to property than the dangers of tornadoes, blizzards, electrical storms and floods in other parts of the country, can be greatly lessened by a thorough knowledge of the location of fault zones and the like, as well as by the adoption and enforcement of suitable buildings regulation in locations where earthquakes are especially likely to occur.

Inventions

Passing Away of R. H. McCormick.—On March 14th last Robert H. McCormick, the inventor of the first self-binder, died at a tourist hotel in Augusta, Ga. Born in Rockbridge County, Va., on September 6th, 1847, McCormick was educated at Chicago University and later spent most of his time in inventing and experimenting with his self-binder and reaper. His experiments were personally conducted in Texas and Minnesota, and he was in charge of the field trial exhibits at the Centennial Exposition at Philadelphia in 1876, when the reaper was introduced to the public as the greatest labor-saving device of the age.

New Idea in Tap Making.—A departure in tap making has the cutting edges at the point ground at an angle to the axis of the tap, in order to cut with a shearing action which throws the chips unbroken ahead of the tap, instead of allowing them to collect in and clog the flutes. Shallower flutes can be used than are possible with the ordinary tap. The new tap does all its cutting with the first few teeth, the remainder of the thread on the tap acting as a lead screw, steadying the tap and producing an accurate thread. It is ground on the angular cutting edge instead of in the flutes, as in the ordinary tap, and may be reground repeatedly until there are only three or four full threads left. It will maintain its size to this limit.

Simplifying the Issuance of Passes.—The issuance of an annual pass, which is a more or less common occurrence in a railroad office, is a somewhat complex operation requiring the writing of many records and filling out of forms, besides that of filling out the pass itself. A labor-saving device which permits of all of these tasks to be performed in a single operation has been devised by Ernest L. Smith, a railroad man of Salt Lake City, Utah. The device is a simple and inexpensive holder made of, and combined in, a single sheet of ledger paper in which the blank pass is held so that it may be conveyed through the typewriter in conjunction with the blank record cards and other forms with the carbon paper inserted therein for manifolding. With this piece of apparatus, the whole business of issuing a pass and making all the necessary records is done at once, including the receipt for the same which is generally forwarded with a pass. The time saved is considerable.

Automatic Air and Car Coupler.—The Pittsburgh railways are making use of a new form of automatic air and car coupler which not only simplifies the matter of coupling and uncoupling cars, but obviates the necessity of a man standing between the cars in order to perform this operation. In order to insure the comfort of the riders it is necessary that the coupling between street cars should be very rigid, and it has been heretofore found difficult to obtain this rigidity in a piece of mechanism designed to stand the hard usage which couplers are subjected to. The present device is so carefully machined as to insure a perfectly rigid connection when coupled together, this being made possible by means of suitable joints behind the heads to provide the necessary vertical and lateral movement. In spite of the neatness of the fit of these parts the couplers will properly come together and lock, though they be as much as three inches out of alinement, and they are sufficiently flexible to operate where the car levels may vary as much as ten inches.

Spiral Pipe in Smoke Stack Service.—In and around Chicago, there are several interesting specimens of stack construction, the behavior of which in service is being closely observed. These are unique for the reason that they are practically formed of a single piece of metal, a long sheet being wound upon itself, the edges being turned and locked upon a narrow strip. The latter, besides making a tight seal, acts also as a reinforcement so that gage for gage, the spiral pipe is much stiffer and stronger than it is possible to secure by any system of riveting. In the making of a reinforced spiral pipe, two strips of steel of different widths are used. Both strips of steel are rolled to shape on the edges and are interlocked and rolled under very high pressure in a special machine which the manufacturing company has patented. The strips of steel are first cut the full width from long sheets and the ends are welded together. The steel is then placed on large spools. Both these strips are fed into the machine at one end, rolled into shape and interlocked in the machine, coming out at the other end on the shape of an endless pipe. At the point where the reinforcing band passes around the pipe there are four thicknesses of metal, which construction gives great rigidity and stability. The inside of the pipe is perfectly smooth, an important consideration as there is no frictional resistance. One of the stacks referred to is 60 feet and 30 inches in diameter. The spiral pipe is also designed for other purposes such as dredging, irrigation, pulp and paper making and brine circulation, and in these capacities, an important consideration is the fact that the interior surfaces are unbroken by rivets or anything else which might offer any obstruction to the movement of the material being conveyed.

Where Cotton Vies With Steel

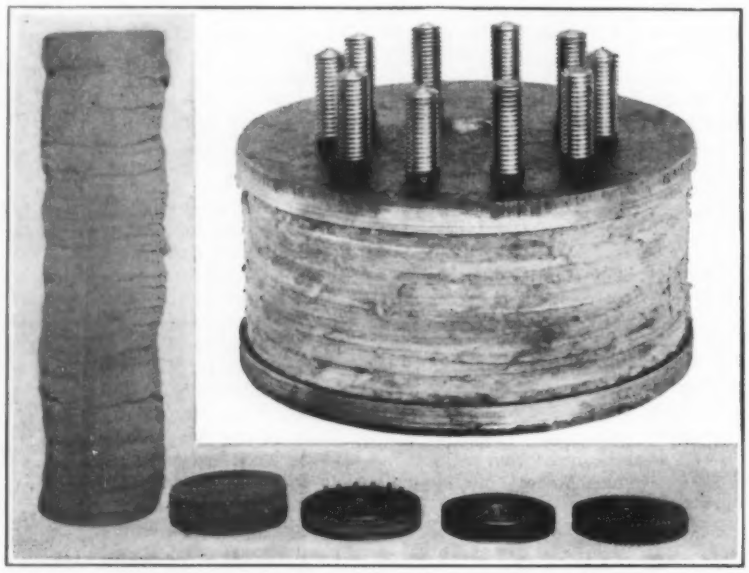
Taking the Noise out of the Machine Shop with Cotton Gear-Wheels

IN one of the shops of a large electrical plant a punch press was in constant trouble with defective pinions. The maintenance bills often ran to forty dollars a month for one gear train. The gear wheels were constantly wearing out. Iron, brass, steel and various non-metallic gears were tried. All but the steel wore out in a few days, and steel gears produced a deafening noise. Right here the Mechanical Doctor was called in to diagnose the case. After trying all the first-aid remedies at hand, he confessed his inability to effect a cure and called in consultation the scientists from the company's research laboratories.

Now scientists have a quaint way of proposing some scheme that is on its face quite absurd, and that has absolutely nothing in its favor except the astonishing fact that it works. Nobody except a scientist would have the audacity to suggest that gear wheels be made from balls of cotton. And of course no practical man would pay any heed to such a suggestion. So it was necessary for this particular scientist to prove his point on his own hook. Consequently, he made a set of gears for the punch press out of cotton; and they have been running in dead silence for five years without noticeable wear!

Steel gears and pinions are among the noisiest creations of man. A shop full of steel gear driven machines, running at high speed, would strike a thunder shower dumb with envy. By replacing these gear trains with cotton-ball pinions this noise is eliminated, much to the comfort and health of employees, and greater efficiency and increased production secured. These new pinions are remarkable for strength, elasticity of teeth and toughness. They will outwear iron or brass and are proof against damage from water, oil, dryness, or temperature changes. They have been adapted for all kinds of machines, from automobiles to turbine engines. Because of their noiseless operation, long life and high tooth strength, they are applicable to numerous types of machine tools such as lathes, planers, traveling cranes, drill presses, shears, punches, etc., and particularly to the back geared motors used to drive such tools. Likewise in spinning frames, looms, silk machines and carpet-weaving machinery they find wide use.

Only the highest quality cotton is used in the manufacture of these gears, and it must be thoroughly cleaned. It is received at the factory in the usual rolls as it comes from the roving frames. These are re-wound on cylinders and compressed by hydraulic pressure into the "blanks" for the gear cutting machines. The usual construction of these "blanks" is to use steel "shrouds" for the sides, with the cotton between, and without any metal bushing in the bore. The cotton filler is compressed under hydraulic pressure of several tons per square inch of side surface, and held in compression by the steel shrouds, or side plates, with the aid of threaded studs passing entirely through both shrouds and filler. In the large gears, having special hubs, or bosses, economy of manufacture requires the use of a metal centre and a separate "cotton" rim. The "blanks," impregnated with oil, are "cut" on the usual gear shapers, or with rotary cutters.



Stages in manufacture of cotton gears showing amount of cotton compressed into a single gear. Above, an enlargement of the third stage

Lithographic Stone as a New American Product

GREAT difficulty has been experienced in the development of the lithographic-stone quarries of the United States in competition with the industry in Bavaria but recent conditions have been favorable to quarrying in this country, and during the past year for the first time there was a considerable production of American stone. This output, according to information received by the United States Geological Survey, was from a large domestic producer who has quarries at Brandenburg, Ky., and an office at Louisville. In 1916 this producer sold 40,000 pounds of finished stone at prices ranging from 2½ to 27 cents per pound. For some years previous small quantities had been sold occasionally in Louisville, but in 1916 the stone was shipped to buyers as far away as Cleveland, Washington, New York, and Boston.

The quarry at Brandenburg contains three distinct beds from which lithographic stone may be obtained. Two of these beds are about 3 feet thick and one 9 to 10 feet thick. They are separated by beds of limestone of other varieties and make up only about 20 per cent of the stone that must be removed. The remaining 80 per cent, however, is available for crushed and pulverized limestone, chicken grit, and other uses, and considerable quantities were marketed for these purposes in 1916.

The chief obstacle to the development of lithographic-stone quarries in this country has been the high cost of quarrying and preparing the stone compared with the Bavarian cost. Much of this European stone is reported to occur in thin layers that require only planing and polishing before use, whereas all known deposits in the United States that are at all suitable for lithographic work occur in more massive beds that must first be sawed into slabs of proper thickness. High cost of labor in the United States and of railroad as compared to ocean transportation have also stood in the way of the domestic industry.

Quarrying of the Bavarian stone involves the handling of large quantities of waste, and the waste piles around the quarries to-day form hills of considerable size. The marketing of crushed stone and similar products from the Brandenburg quarry should go far toward eliminating the cost of quarrying from the expense of preparing lithographic stone. With this advantage it may be possible even after the European war is over to market the Kentucky stone in competition with the Bavarian stone, the better grades of which under normal conditions bring 5 to 6 cents per pound for 10 by 12-inch slabs, and the poorer grades 1½ cents a pound for slabs of the same size.

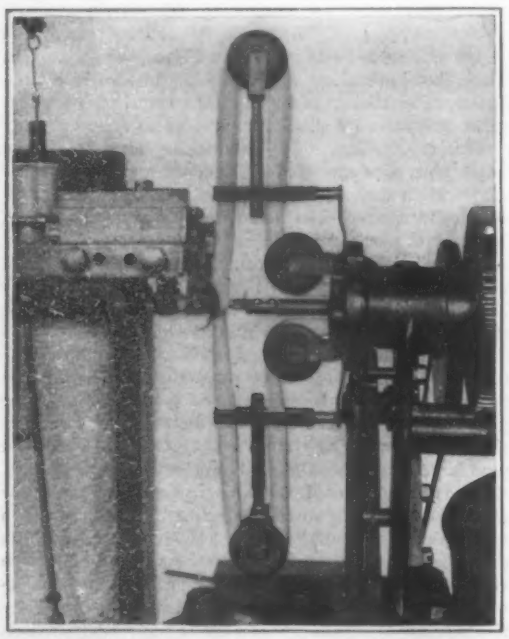
The Current Supplement

A SUBJECT of great importance in relation to our food supplies is treated in an article in the current issue of the SCIENTIFIC AMERICAN SUPPLEMENT, No. 2151, for March 24th, in an article on *The Biochemical Analysis of Nutrition.*

The valuable article on *How Eclipses Occur* is concluded in this issue. *Inferences Concerning Auroras* gives certain physical facts concerning this spectacular phenoma, *How the Government Protects Its Revenues* is an interesting article telling something of the work of the Appraisers' Stores, in New York; it is fully illustrated. *Graphic Control* deals with scientific executive management of manufacturing establishments. *The Movements of the Earth's Poles* discusses investigations of the nature and course of these wanderings. Other articles of value are *Structural Engineering, Cast Iron Growth* and *The Lumen Unit of Illuminating Power.*

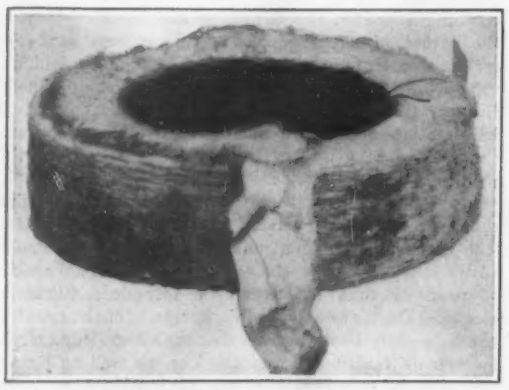
Units of Viscosity

THE Bureau of Standards has been engaged in determining the viscosities of aqueous sugar solution over a wide range of temperature. In this connection the Bureau states that the most probable value for the viscosity of water at 20 degrees C. is found to be 0.010050, and suggests that it would be advantageous if this value were used uniformly in calibrating instruments. Since this value is very nearly 0.01, it is proposed that the one hundredth part of the absolute unit of viscosity (the poise) be called the centipoise, and that viscosities be expressed in terms of this unit.

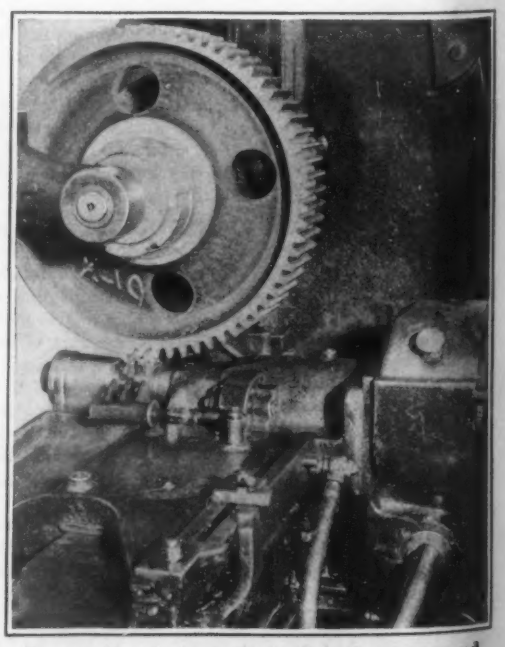


Winding the cotton into a cylinder which will later be compressed to make a gear

A blank and finished gear of cotton



Partly compressed cylinder ready for assembling with metal parts



The machine that cuts the teeth in the compressed cotton blanks

The Autoplane—A Limousine for Land and Air Travel

A LUXURIOUS limousine with a highly-finished body and with its three occupants sitting in elaborately and comfortably upholstered seats, dashing along a road or even over a field at the rate of 45 miles an hour, and then, with a slight increase in speed, taking to the air by virtue of its short wings and soon reaching a speed of 65 miles an hour and showing all the ease of maneuvering which belongs to the modern aeroplane—all this would seem to be a description of the perfected aerial 'bus or autoplane of a decade hence. Yet it is a delineation of the autoplane which was exhibited at the recent Pan-American Aeronautic Exposition held in New York, and which, from the popular standpoint at least, might well be regarded as the big surprise of the occasion.

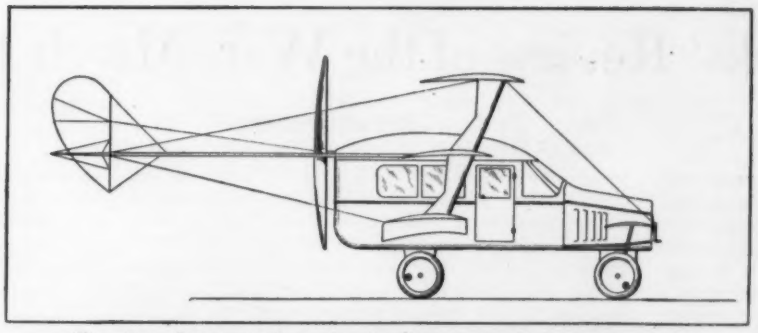
The autoplane has been designed by Glenn H. Curtiss and his engineers, and is undoubtedly the first attempt ever made to combine automobile engineering with aerial practice in order to develop a vehicle for fashionable use. The machine is a modified triplane, with the planes slightly staggered. The two upper planes have a span of 40 feet 6 inches, while the bottom plane is 23 feet 4 inches; and the chord of the former is 48 inches, and that of the latter, 42 inches. A gap of 39 inches is left between the planes, and the stagger is 11 inches. The over-all height is 10 feet, length 27 feet, and the useful load 710 pounds.

The body of the autoplane is of aluminum, while the windows are of celluloid. The interior, with its elaborate upholstery and tapestries, compares favorably with that of the high-priced limousine; so, with the single exception of perhaps a slight reduction in size, the appointments leave nothing to be desired. The body has been somewhat streamlined to reduce the head resistance, and if anything this adds to its smart appearance.

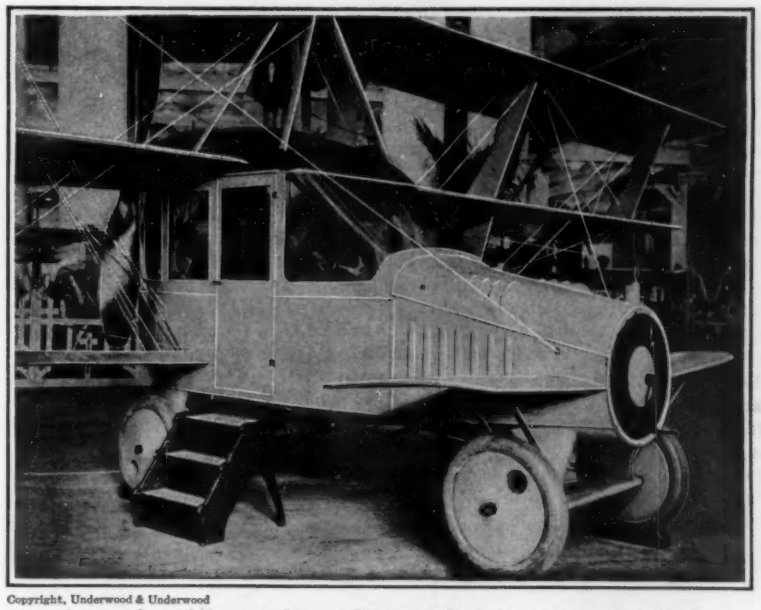
The power plant, a 100-horse-power, eight-cylinder motor, is placed under the hood in front of the autoplane, following automobile practice, and the shaft is extended to the rear of the body where the power is transmitted by a chain drive to the four-bladed propeller located on a line with the top of the body. The circular radiator, which provides water cooling for the engine, is placed in front of the hood and greatly adds to the automobile-like appearance of the machine. Still another feature in this direction is the thermometer cap of the radiator and the starting crank.

The autoplane travels over the ground much in the same manner as the conventional motor car, and can be steered by means of the front wheels which are equipped with the usual steering mechanism. The front wheels move in unison with the aerial rudder; and all four are sprung on concealed rubber shock absorbers, which adds to the running qualities of the machine during land travel and in alighting.

Despite its apparent bulkiness, the autoplane is believed to be quite practical for the purpose intended. With a fuel capacity of 30 gallons and a consumption of 10 gallons per hour, it has a range of travel of something like three hours at the maximum speed. The fuel tanks are located in the space above the passengers' seats and just forward of the propeller, while the engine carries four gallons of lubricating oil in its crank-case. The machine is designed to sell in the neighborhood of $10,000.



Elevation of the autoplane, showing the staggered planes, propeller and tail features



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A near view of the autoplane as it appeared at the recent aeronautical exposition held in New York

The Geared Drive in Ships of Large Power

THE Steam Engineering Bureau to which falls the duty of deciding upon the motive power which shall be used for ships of the Navy, has selected the geared drive for the 90,000-horse-power scouts of the present naval program, but has rejected it as a drive for the battle-cruisers of 180,000-horse-power. The testimony of the Chief Engineer, Rear-Admiral Griffin, as given before the Senate Naval Committee, would make one suppose that in his judgment an increase of 100 per cent in the power to be transmitted, that is a jump from 90,000 to 180,000 horse-power, would introduce some problems of construction or operation, which would jeopardise the success of the gear if used with the larger power. What these possible drawbacks are we do not know, and after looking into this question quite carefully, we find nothing whatever, either in practice or theory, to justify the Admiral's apprehensions.

Evidently, he is not disturbed by the mere magnitude of jump in total power to be transmitted, for he has not hesitated to proceed from the installation of 7,000 horse-power in the "Jupiter" to one of 180,000 horse-power in the battle-cruisers, an increase of over 25 times; and the fact that he can view a jump of one to 25 in the electric drive with equanimity, and regards a jump of one to two in the geared drive with very serious misgivings, naturally raises the question in one's mind as to what in the world can be the disastrous possibilities, mechanical or otherwise, which the Chief Engineer foresees in the proposal to use the geared drive in the battle-cruisers.

For it is well understood among the builders and users of gears for the transmission of large powers, that the crucial point to be considered is the maximum amount of pressure per inch, to which the engaged teeth of a reduction gear will be subjected. Under the conditions in these ships a tooth pressure of 800 pounds is well within the limits of current practice.

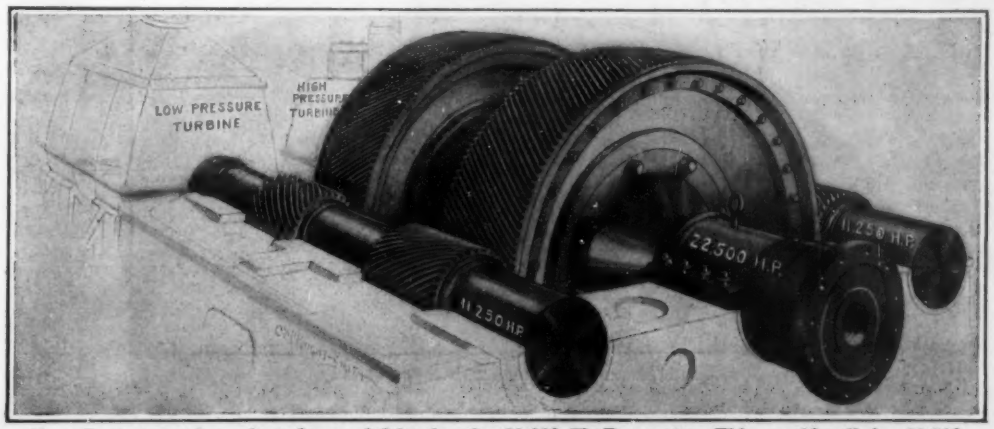
By way of making the problem clear to our readers, we present the two accompanying drawings, one showing an application of the geared drive to our 90,000 horse-power scouts, the other showing how it might be applied to the 180,000 horse-power battle-cruisers. In each case the design has been worked out on the basis of a maximum tooth pressure of 750 pounds per inch of face, measured across the pinions. In the case of the scouts, the power is developed on four propeller shafts, each carrying 22,500 horse-power. Each shaft is driven by a high- and low-pressure turbine, the high-pressure turbine driving a shaft whose pinion transmits 11,250 horse-power to the propeller-shaft gear, an equal amount being transmitted by the low-pressure turbine through a pinion which is placed diametrically on the opposite side of the gear.

In the case of the battle-cruisers, the power is developed in four turbines (two high and two low) and is transmitted to the gear by two sets of pinions placed diametrically on opposite sides of the gear, each pinion carrying, as in the case of the outfit for the scouts, a total of 11,250 horse-power, and with practically the same tooth pressure.

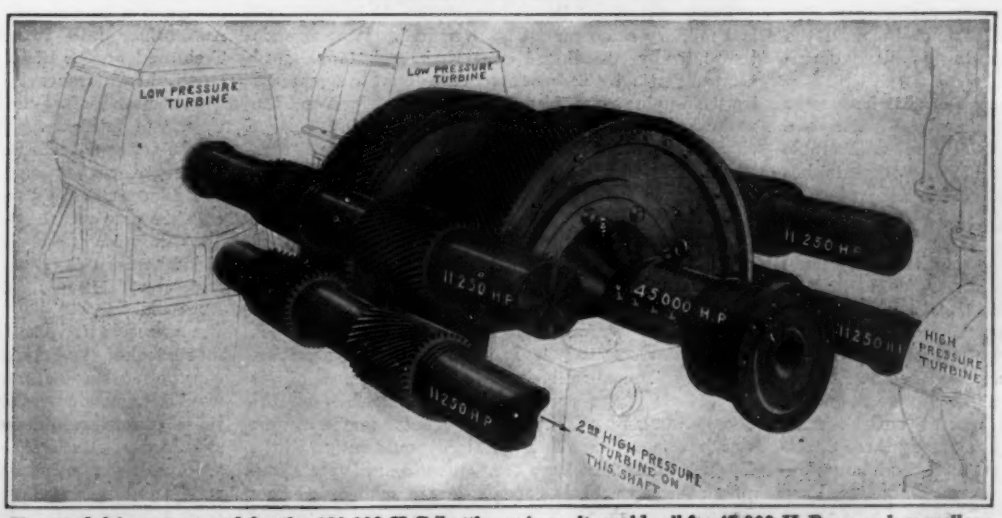
Now presupposing equally good workmanship, and remembering that in each case the horse-power, revolutions and tooth pressure of each pinion are the same, it is difficult for the mechanical engineer to understand just why it is that Chief Engineer Griffin should have so little faith in the one installation and such absolute faith in the other.

Mechanically considered, the only change necessary, so far as the gears are concerned, is to provide in the web of the main gears sufficient additional strength to meet the heavier shearing

(Concluded on page 314)



Navy Department has adopted geared drive for the 90,000 H. P. scouts. This would call for 22,500 H. P. on each of the four propeller-shaft gears, and 11,250 H. P. per pinion, if two pinions were used for each gear



If geared drive were used for the 180,000 H. P. battle-cruisers, it would call for 45,000 H. P. on each propeller-shaft gear and 11,250 H. P. per pinion, with four pinions for each gear. In both scouts and battle-cruisers a unit tooth pressure of about 750 pounds to each linear inch of the engaged teeth would be used

Two Weeks' Review of the War, March 15th, 1917

By Our Military Expert

THE past two weeks have been indeed fraught with great events, but in a direction entirely unexpected to the casual observer. In general all eyes are very naturally cast toward the happenings upon the western front, where the continued withdrawal of the German forces in the Somme region—by small distances, it is true, but in the aggregate by serious losses of strategic positions and ground—has now reached a point where Bapaume must either be given up under the strong pressure of the English forces or else a successful resistance must continue to be made and the lines held. The latter seems impossible under present conditions and early withdrawal to a new line some distance to the rear is practically a certainty. Where that line is, no one outside the German General Staff knows, but, to the military eye, it is most natural that it should begin at Lens and pass in front of Douai and Cambrai to the Scheldt; it would then extend along that river, taking in St. Quentin, LaFére, Laon, Neufchatel, joining the present line at Rheims, and on to Verdun. This would mean the abandonment of a large extent of ground that has been so carefully prepared and so long held on the defensive—it would also mean explanations at home that would be far from satisfying to the German people who have been and are now bearing so much privation, want and even starvation for the Kaiser and the Fatherland, and who have been led to believe so strongly in the invincibility and ultimate victory of their land and naval forces. Such a retirement of the troops would, however, get rid of the dangerous salient that has so long existed on the line Péronne, Roye, Noyon, and that under present conditions may be broken at any time. What the ultimate objects of the British advance are can be known only to the Allied commanders; but, if once the German line now so heavily pressed at Bapaume can be pierced, and the railroads in rear can be cut, the immediate withdrawal of the Germans to or near the lines indicated above and along the Scheldt will be necessary. This would mean the abandonment and surrender of a large portion of the positions occupied in France and later in Belgium, and would be the sure forerunner of defeat by their opponents and of a revolution at home. One thing is certain—that such a surrender will take place only after most severe fighting and serious losses in men and material.

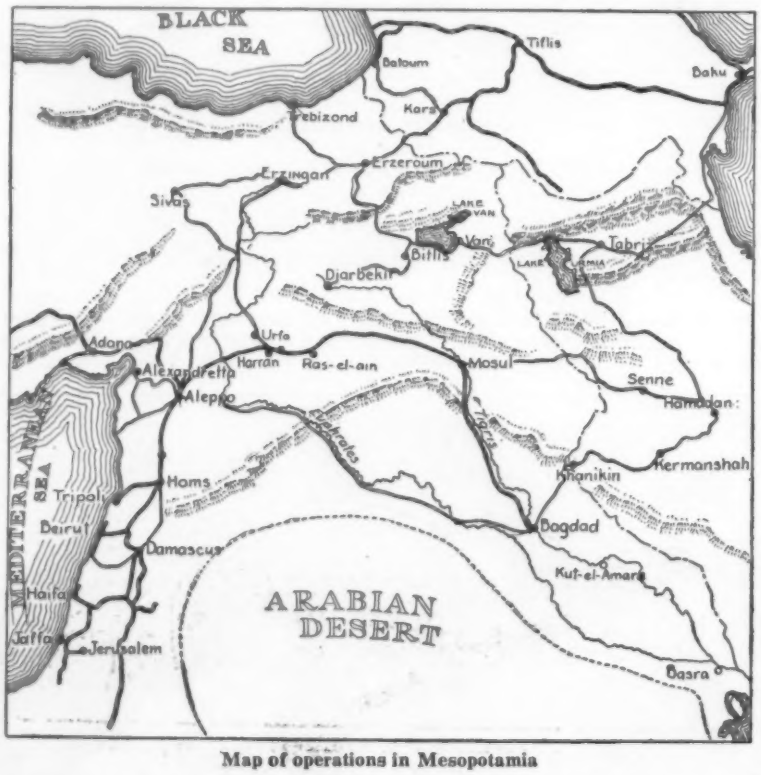
The forward movement this spring may be decisive for the Entente armies, but the sacrifice of one million men may be the price paid for victory on the west front alone. The wonderfully trained and efficient army brought into Belgium and France by Germany three years ago has practically disappeared; if a retreat along the Meuse back to the Rhine is made necessary by the spring and summer operations, scarcely one man of the vast armies that so proudly moved forward in 1914 will return along the scenes of their once triumphal march so filled with hopes of victories and conquests. The principal contests at present are in front of Bapaume as stated; there have been some artillery and infantry actions in the Champagne front around Verdun and along the western part of the lines held by the Belgian forces. So far no decided results have been obtained, and cannot be until the return of spring and good weather render military operations possible on a larger scale.

On the eastern or Russian front, there has been some fighting along the lines connecting the Russian and Rumanian frontiers; but extremely cold and unfavorable weather has rendered any extended movements impossible. The same can be said of the happenings in Macedonin, where only artillery actions or areoplane contests have occurred.

The Italian and Austrian troops on the Carso plateau as well as in the Trentino region have done but little in the way of offense on either side due to weather conditions. But it is evident that connected action on every point of the ring that now encircles the Central Allies in Europe has been agreed upon by the Entente and that it will not be long before the effects will be seen on every side. Certainly the present outlook must give rise to many anxious thoughts among those directing the military operations on such a tremendous scale—especially when, as is now well known, the material and physical resources of the Central Powers are so nearly exhausted.

The romantic period in some of the campaigns has now been reached in reviewing the movements in Mesopotamia and Palestine. Some time ago attention was called in these columns to the possible consequences of military successes in these two countries; the operations now under way show again the unity of action of the Entente Allies and their grasp of strategic operations on a large scale—something learned from that marvelous organization, the German General Staff. In the last review here given, the British forces in Mesopotamia had taken Kut-el-Amara on the Tigris by a very creditable military movement, advancing up the Tigris and from the Euphrates along the Shatt-el-Hai, a canal connecting the Euphrates at Nasiriyeh with the Tigris at Kut. A quick flanking movement from the south bank to the north bank of the Tigris west of Kut threatened the entire Turkish forces engaged in its defense and required a hasty retreat that, from all accounts, developed into a rout. Throwing away and abandoning large quantities of military supplies and even several river steamers and many bridge pontoons, the Turkish troops fled in disorder along the north bank of the Tigris over the few river roads and across the marshes that extend nearly to Bagdad. They were hotly pursued on both banks of the river by the British-Indian troops with the loss of many prisoners enroute.

Even at Ctesiphon, the scene of Gen. Townshend's defeat in 1915, and where strong defensive works had been erected, no resistance was made; finally a halt at the Diala River was made and some resistance offered. But by a flank movement across the Tigris and in rear of their troops the Turks were routed and dispersed and Bagdad was entered by the British forces on Sunday, March 11th. The pursuit of the fleeing Turks beyond Bagdad is still being carried out by the British cavalry.



Map of operations in Mesopotamia

The importance of Bagdad's capture both in a political and military sense cannot be overrated. It commands the routes by Khanikin, Kermanshah, and Hamadan to Central Persia, by Tadmor across the desert to Damascus by the Euphrates to Aleppo, and by the Tigris and the unfinished railroad to Mosul. As it was the base of supplies not only for the Turkish army on the Tigris around Kut, but also for the forces in Persia, its loss will be a serious menace to both these armies. Politically not only is British prestige raised throughout the east, but the whole Mohammedan world will be moved by news of its capture; it may well be asked whether this event is not a marking point in the possible downfall of the Ottoman Empire.

Simultaneously with the British movement up the Tigris the Russians in Persia began their advance. Capturing Hamadan again after their retirement of last year, their troops are already in Kermanshah on the Mesopotamian borders. A cross-country march in time to Djibarra or Samara on the Tigris would cut off all the Turkish forces that have been operating in lower Mesopotamia and would thus open a clear marching road from Bagdad through to Mosul, the eastern end of the old caravan route between the Tigris on the east and the Euphrates and Aleppo on the west. It is noted in recent telegrams that the Russians have taken Senne; this is an important town on the main road from Hamadan in Persia through northern Mesopotamia to Mosul. They have also captured on another road to the north of Senne (Sinnah), only a short distance from the Mesopotamian border, but in the direction of Mosul. An examination of any good map of Turkey in Asia will show the object of all these operations. The Russians now occupy lines extending from Trebizond on the Black Sea to and through Erzingan on the western Euphrates—thence southeast to Bitlis and Van into Persia, south of Hamadan and Kermanshah. That is, they control the greater part of Armenia and are preparing to move across the Anti-Taurus mountains in the direction of Sivas and Angora. In Palestine the British troops were last reported about fifteen miles from Jerusalem and, unless unexpected opposition is encountered, that city, so holy in the eyes of the Mohammedan, Jew and Gentile, must soon again be restored to Christian domination after centuries of Turkish control. After such an event one of the first operations will be to secure the railroad from Jerusalem to its port of Jaffa on the Mediterranean; this will enable both troops and supplies to be readily brought in. Another operation will be the cutting of the Hedjaz railway, running from Damascus into Arabia; this road is only about thirty miles east of the Dead Sea and its loss will necessitate the hurried retreat of all Turkish forces along its line south of the break. If a stand is made by their army it will be somewhere between the mountains of Lebanon, the river of Jordan, and the Dead Sea, to protect the railroad to Damascus. While the destruction of the Turkish army is the primary object of the British commander, no doubt he will be equally anxious as he advances to possess himself of the branch railroads connecting the Hedjaz railway with the sea at Haifa, St. Jean d'Acre, Sidon, Beirut and Tripoli; for these are all equally essential as bases of supplies as the army comes northward. The ultimate object will be the capture, on the one hand, of Aleppo and on the other of Adana, at the head of the bay of Alexandretta; for here the Berlin Bagdad railway runs within twenty miles of the sea and can be readily reached by an army of sufficient strength landing at Alexandretta and moving north. The vulnerability of the road at this point has been so evident that it is reported a body of German troops 10,000 or more in number has been held here to resist a possible invasion. This place is doubly important, being situated practically midway between the tunnel through the Taurus mountains at the famed Cilician Gates on the west and the Amanus Pass at the Gates of Asia on the east. It has been claimed that rails have been laid from Konia on the Anatolian section to the Taurus tunnel (still unfinished); transport over the mountains by motor to connect with the eastern break near Adana is now available and will be so until the tunnel is completed two years hence. The same can be said of the Amanus tunnel, transport over the mountains to connect with the railroad to Aleppo being obtained by means of a light railroad already constructed. The value of Adana in a military view can be well understood by consulting the maps of this region. The Taurus mountains divide Asia Minor into two sections as they extend from Trebizond on the Black Sea to the bay of Alexandretta on the Mediterranean. There are three entrances over these mountains into the western section or Anatolia, *i. e.*, by way of Trebizond, Erzerum and the pass near Adana known as the Cilician Gates. Russia has already taken the first two; when England has done her share by means of her fleet and armies and has taken the vilayet of Adana with the pass over the mountains to the west, then all the Turkish forces in eastern Asia Minor will be cut off and Turkish rule in Palestine, Armenia, and Mesopotamia will have ceased. In fact, the power of the Turkish Empire is fast crumbling and only the most unexpected happenings can now save it. The new kingdom in the Hedjaz with its control of the holy cities of Medina and Mecca, the capture of Bagdad, and certainly of Jerusalem will exert a tremendous effect upon Turkish influence in all those countries so long subject to the rule of Constantinople. Decisive conflicts in Palestine and Mesopotamia can be expected at any time, leading to great results and to change of rulers. Already it is said that a reign of terror exists in Jerusalem, Damascus and Aleppo, many of the prominent men in the three cities having been arrested and executed for disloyalty to Turkish rule.

Correspondence

(The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.)

The Big Gun Is Supreme

To the Editor of the SCIENTIFIC AMERICAN:

Recently you were kind enough to publish a protest of mine against the tendency in modern naval criticism to value speed and gun power in capital units over generous armor protection.

The inspiration of this letter came to me instantly as I was reading an article on naval development by Mr. Simmons in the New York *World*.

It seems to me that in view of the fact that the generality of people are extremely hazy about the finer points of naval construction and strategy, those who write for the public should be careful lest they woefully mislead those who read them.

I have been a lifelong observer and student of naval development and problems, and must say that I grow restive under error.

The generality of people are not clear as to the difference between a capital unit and a gunboat. But it pains me in the extreme when I see just as great or greater errors in print.

With respect to Mr. Simmons' article I do not record such gross errors as just above referred to, but I am sorry to have to consider it as sufficiently misleading about naval conceptions as to call for comment.

For instance, a very great error attaches to Mr. Simmons' observations with respect to the functions and I might even say, importance, of secondary batteries in capital units. Really I had thought we had long ago passed this stage. He goes back to the Spanish-American War and extracts lessons from the havoc wrought by secondary batteries in the destruction of Cervera! This is useless. Those were the days of the crude stage. Mr. Simmons might as well have referred to the "Monitor" and "Merrimac." Later development has relegated the secondary battery to defense against torpedo attack. It is true that secondary batteries may be of very great use in actions between secondary vessels, like that between the "Sydney" and "Emden" in the present war, but in battles of modern super-dreadnoughts, anything less than 12 inches in caliber is of no more use whatever than a popgun.

All this was known before the outbreak of the present war, but how the same error can still be made in the teeth of what has but lately been emphasized by hard experience is strange indeed.

Any number of actions may be called to mind. For our purpose perhaps the most convenient are those involving Admiral von Spee. When he met Craddock his deadly superiority of 8.2-inch guns above 6-inch guns on the British cruisers made itself manifest in short order. Craddock was annihilated and British naval prestige, in this hemisphere at least, was very low. But at this time there came a change in the complexion of British naval control. Civilian and unaggressive technical fiber gave way to Baron Fisher. What did he do? Detach immediately from the Mediterranean station two swift capital units, of minor strength to be sure, still capital units. These two capital units reached the Falkland Islands just a day before von Spee, and strangely enough neither force was looking immediately for the other. But when von Spee saw the tripod masts he believed, and correctly, that his hour had come. His ensuing destruction was a foregone conclusion.

It would be wasteful to emphasize further on this point. Since this letter is growing long, I will not touch on several other criticisms of Mr. Simmons' article that were pressing on my mind, but will pass immediately to what I consider an error made not only in this article but also one of easy acceptance.

Mr. Simmons, in common with others, speaks of the latest additions to our capital units as the most heavily armed in the world. An example, sufficing for all of the class, is the Pennsylvania, displacing over 31,000 tons and carrying twelve 14-inch weapons. But not content with mere statment, American pride dilates on the fact and erroneous impressions are created. It is not evident to me wherein the Pennsylvania is much superior to the British "Queen Elizabeth," which Mr. Simmons specifically selects for comparison.

To begin with let us take actual weight of metal thrown. The "Queen Elizabeth" carries eight 15-inch guns. The British 15-inch weapon throws a projectile weighing 1,950 pounds. Our 14-inch shell weighs only 1,400 pounds. Result: Weight of metal for "Pennsylvania" 16,800 pounds; for "Queen Elizabeth" 15,600 pounds. Where is the great disparity in these figures?

But there are other considerations. If, as I am wholly inclined to do, we accept the experiences of this war as vindicating the big gun it would rather appear that the "Queen Elizabeth" were superior in armament to the "Pennsylvania." Our naval experts cannot explain away to me the difference in striking power between a projectile weighing 1,950 pounds as against one of only 1,400 pounds.

I look upon the "Queen Elizabeth" as a step in the right direction in preference to the "Pennsylvania." In a combat between the two vessels, equally served, I would hate to abide the result, being an American.

Mr. Simmons in referring to British latest construction does not even hesitate to compare the "Pennsylvania." It certainly appears sufficient only to state that any vessel carrying a battery of 18-inch guns that would shoot would knock the "Pennsylvania" into junk in no time.

I am not clear yet whether a reversion to the "Monitor" type or further increase in size of units and number of guns is the correct line of naval developments. There is much to be said on either side.

W. F. JOHNSTON.

Palo Alto, Cal.

Why Not Revive Chain Shot?

To the Editor of the SCIENTIFIC AMERICAN:

I have it on the authority of two well-known officers of the French artillery, that the Allied armies depend more upon high explosive shells for the destruction of barb-wire entanglements, than on any other single means.

This means that, unless a shell bursts sufficiently close to a support so that its location is included in the ensuing crater, the chance of the dislocation of the support is small indeed. The breakage of the wire must be accomplished, generally speaking, by fragments of the shell, or by detritus sufficiently hard and heavy to withstand the impact. Of course, if circumstances favor the explosion of the shell, the mere concussion may flatten the entanglement, but is it not probable that little is accomplished in this way?

I have wondered continually, since all former methods of fighting have been superseded as desired or found necessary, why some modern adaptation of the old chain

A 3-section shell in closed and open positions

shot could not be used to good advantage. True, this is not allowed by international law, but just what is international law, in the light of daily events?

For instance, suppose a shell were made in two or four sections, connected by light chains of good material, and these sections were banded together lightly for loading and firing, the bands being so proportioned that their disruption would be a certainty when fired from a gun. Suppose these sections enclosed the chain, up to the moment of firing, so that there would be no inconvenience in handling. Suppose also that these sections, which we may now call a shell, were assembled as the projectile of a 105 mm. unit of fixed ammunition. (See sketch.)

A proper calculation of weights and center of gravity would give any form of gyratory motion desired, presumably for moderate ranges only. When fired, the projectile would open up, assume its gyratory motion about the junction of the chains as a center, roughly speaking. The effect of such a projectile on entanglements can readily be imagined, and if made heavy enough, would easily shear itself through several strands of wire. No support could withstand the impact of the chain, let alone the section of the shell. It would be in effect a three- or four-pointed star, revolving at a high speed. Such a projectile, being designed for use at moderate ranges, and for a target reaching for miles, could hardly fail to hit. It could, and should probably, be fired from the more nearly obsolete guns, in order not to injure the rifling of an efficient gun. In fact, in many cases, old smooth bores or trench mortars could be used.

Suppose you ask through your columns why some such method has not been tried. It might produce an interesting reply.

ROBERT G. PILKINGTON.

Chicago, Ill.

Furnace Logic

To the Editor of the SCIENTIFIC AMERICAN:

I read with pleasure the article "Heating a Porous House," by George H. Cushing, in the issue of December 30th, 1916, and desire to take this means of complimenting Mr. Cushing through you for the careful and logical investigation he made into the difficulties encountered in heating his home.

The matter of properly heating a building in which people live is one of those items in building construction which receives as a general rule very little thought or consideration. Of course, there are exceptional cases where the owner feels that a thorough study of the conditions by a competent heating engineer is not only desirable but necessary. Such a study almost invariably results in a home which can be comfortably heated not only during the mild weather of early fall and late spring, but also during the furious blasts of January or February gales. With a little forethought, the owner has assured himself against illness or discomfort from cold or drafty rooms during his entire period of residence in his home.

Mr. Cushing has, I believe, put his finger right on the spot when he said: ". . . the man who built the house had tried the common thing; he had attempted to limit the first cost. . . . When once started upon a policy of sparing original expense, there was no logical place where he could quit. Thus, he bought a furnace two sizes too small."

Would any man buy a suit of clothes of which the trousers were too short in order that he might save fifty cents or a dollar? Why, then, will people try to save on the very item in building construction upon which their health and comfort depend? If it is ignorance or indifference that causes such lamentable conditions (and I believe that these are the reasons), then this subject should have far more publicity than it has hitherto enjoyed; and I feel that your paper has made a fine contribution toward bringing this matter home to people in the publication of Mr. Cushing's article.

ALBERT L. BAUM.

New York, N. Y.

Sun Dogs

To the Editor of the SCIENTIFIC AMERICAN:

It was Thursday noon, December the twenty-eighth, with the weather a few degrees above zero, really comparatively mild for a North Dakota winter. The thermometer, however, began to drop and the sun dogs heralded the coming cold. Such sun dogs one may not see again in a lifetime, certainly not more than once in a rare winter. At each side of the sun a sun dog stood, a condensed little rainbow with the red toward the sun, showing but little curvature, and not a great many times longer than it was wide with no great width at that. But what made these the sun dogs of sun dogs was the narrow band of light, readily visible, still not without a certain quality of faintness, that stretched from one sun dog to the other, not overhead, but to the north and no higher than the sun stood to the south. Twice the distance that each sun dog was from the sun this ring of light widened into an irregular disk of light that seemed each a second sun dog with the colors so faint that the eye could only discern them as a faint white light. It seemed as if we stood beneath a huge terrestrial ring with the sun a solitaire, the sun dogs its setting, and the narrow platinum band widened into a small disk to either side of the finger, a design for a master craftsman.

The sun dogs rose with the sun and stood with the sun till three o'clock in the afternoon, but the ring lasted only from about eleven till a little past noon.

C. L. MELLEN.

Fargo, N. D.

Eggs by Artificial Daylight

To the Editor of the SCIENTIFIC AMERICAN:

I wonder if we have stumbled onto a scientific discovery this winter as to the relation and use of electric light in egg production? About December 1st last we came across a mixed lot of chickens for sale cheap and bought them, though we were not very well prepared to take care of them.

We had a large old barn to begin with and plenty of feed, mostly cracked corn.

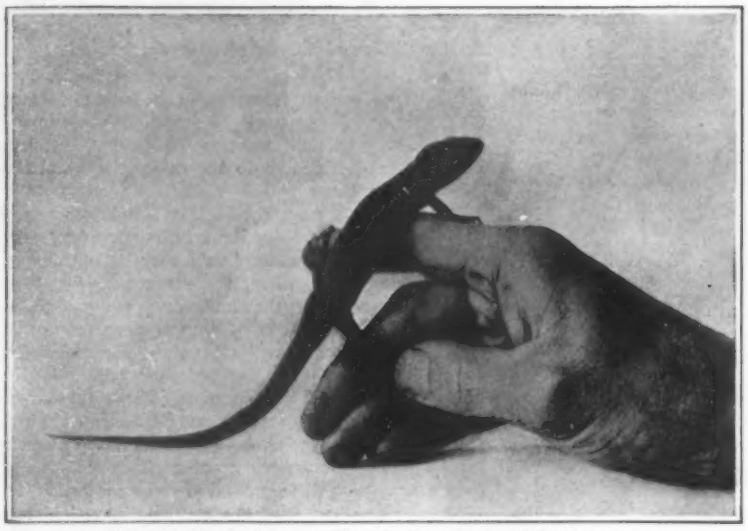
But as soon as convenient we closed off and covered over with paper a double stall, for night quarters, leaving but little daylight; and mostly for the little warmth it might afford, we put in a single 50-watt light.

To our great astonishment our chickens began to lay eggs, and they have since literally turned night into day, cackling and behaving in liveliest fashion, and laying practically all their eggs in the night—sometimes three or four even after 10 p. m. Still it would be so cold it would freeze their combs and of course the eggs that lay over till morning.

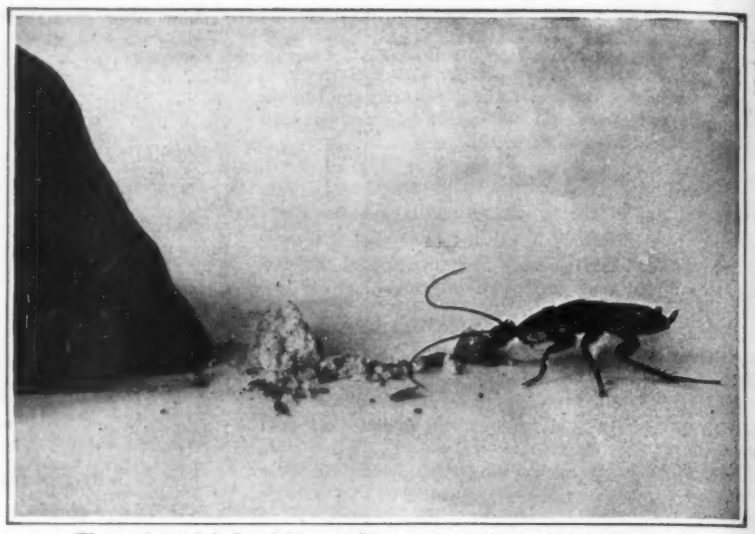
As I said, very few eggs were laid during daylight, but only from 8 to 12, after the light was switched on, and that by a flock of mixed hens—mixed both as to breed and age.

O. B. STEPHENS.

Bemidji, Minn.



The smaller specimens of lizards are amusing little fellows



The cockroach is inquisitive and known to make an interesting pet

Novel Pets and How to Keep Them

Hints for Nature Study Sections of Schools

By Percy Collins

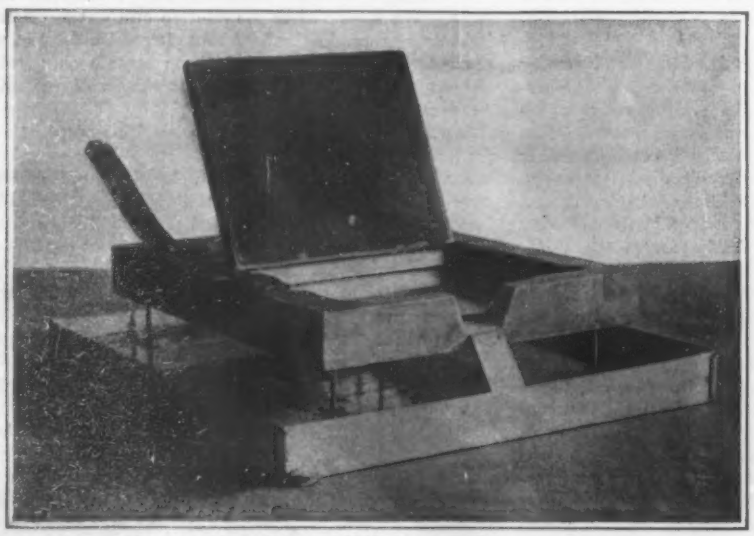
MANY people are under the impression that pet-keeping is a pursuit unworthy of manhood's years; yet nothing could be further from the truth. More than one prominent biologist has discovered that there is no surer way of discovering the true functions of an animal's appendages, and the inwardness of its behavior, than by making a pet of it. For this reason, if for no other, there should be a pet keeping division attached to the nature study section of every scholastic establishment, and a definite scheme of "pet watching" should be instituted. In this connection one is reminded of the story of Agassiz and the new student who was left by the great master with the instructions: "You are to look at this fish carefully, and tell me when I return how much you have seen. You are not to cut it or use any instrument upon it." Agassiz left the student alone with the specimen for several hours. When he returned, he asked the student what he had seen, and on being told, remarked: "You have not looked very carefully; keep on looking." For three long days the youth was made to gaze at the fish, Agassiz returning occasionally to listen to his fresh discoveries. In after years, the student said: "This was the best zoological lesson that I ever had, a lesson whose influence has extended to the details of every subsequent study." Even so is it with pet keeping. To shut up animals in suitable cages, and to feed them with appropriate food is, in itself, a futile exercise; but if the captives are systematically watched, and their doings carefully recorded, the outcome is a fine basis of scientific training. Nor is it always necessary to restrict the liberty of the creatures whose habits we may wish to observe. By the exercise of a little patience, we may make friends with the wild things in their accustomed haunts, this method of study being especially adapted to the inmates of our houses and gardens.

One of the most remarkable pets was a big, hairy "Mygale" spider which a gentleman, resident in Bermuda, actually trained to live among the curtains of his bed, and rid him of the flies and mosquitoes that disturbed his nightly rest. "I fed him with flies (he writes) until he began to find himself in very comfortable quarters, and thought of spinning a nest and making a home. This he did by winding himself round and round, combing out the silk from the spinnerets at the end of his body till he had made a nest as large as a wine-glass, in which he sat motionless until he saw a fly get inside our gauzy tent; then I could fancy I saw his eyes twinkle as his victim buzzed about, till, when it was within a yard or so of him, he took one spring and the fly was in his forceps, and another leap took him back to his den, where he soon finished the savory morsel. Sometimes he would bound from side to side of the bed and seize a mosquito at every spring, resting only a moment on the net to swallow it."

Cockroaches are also readily tamed, and may be accustomed to take food from the fingers of their human friends. Anent these insects, Dr. L. O. Howard has a quaint story. "A croton bug (he writes), of the usual inquisitive turn of mind, inhabited my office desk, and as soon as I laid down my cigar upon the edge of the drawer the little fellow invariably came out of his hiding place, and worked vigorously at the moist end. At first he was after the moisture, but later the tobacco taste grew and he became as much addicted to the habit as the most inveterate human tobacco user. It may be worth mentioning that it seemed to have no appreciable effect on his health." Those quaint creatures, the rearhorses or mantes, also make capital pets, but their pugnacious disposition is such that there is some difficulty in keeping more than one specimen at a time in the same vivarium. Sooner or later there is sure to be a fight, with the result that the stronger insect invariably kills and eats the weaker. Several observers bear witness to the truth of the statement that the female rearhorse, at least in the case of certain species, almost always destroys the male after mating has taken place. These mantes must be supplied with a great quantity of insect food, preferably in a living condition, otherwise they will quickly pine away and die.

Among other large insects that have been successfully kept in captivity may be mentioned the great West African Goliath beetles. They have more than once been seen in the Insect House of the London Zoological Society, and are not difficult subjects to deal with, as their food seems to consist exclusively of nectar, sap and similar sweet juices. But unfortunately, like so many other interesting creatures, they cannot be bred in confinement, so that if their complete life-history is to be unraveled, they must be studied in the tropics.

Probably the best of all insect pets are the social ants, bees and wasps. Given appropriate conditions, most of these insects may be kept under observation in an ordinary dwelling-room, and with reasonable care the colonies will persist from year to year for an indefinite period. In the case of bees, the ordinary precautions set forth in books on apiculture must be observed; but it is usual to restrict the increase of the swarm, the most convenient "observation hives" being of small dimensions. The manner in which these hives are constructed may be gathered from the accompanying photograph. The glass sides should always be screened from light when the bees are not actually being studied, while the insects go to and fro through a tube connected with a small hole in the nearest window-sash. Social wasps may be kept in like manner, a nest in the early stages of construction being taken in early summer. Many of the smaller species of ants require no liberty, as in nature they rarely or never leave the seclusion of their subterranean nests. They feed upon such nutritious matter as they unearth in the course of their excavating, or upon the sweet exudations of the aphides which live upon the roots of plants. Such ants may readily be housed between two sheets of glass, which are kept from actual contact by means of narrow strips of the same material cemented to the edges of one sheet—as shown in the photograph herewith. The top sheet of glass is eventually clamped into place by means of steel clips. One opening must be left, through which a little water and a small quantity of honey should be introduced about once a month during the summer—the opening being carefully plugged with cotton wool when this necessary attention has been rendered. For a small ant colony, a very good home may be made from an ordinary photographic printing frame mounted upon steel nails and thus supported in a shallow dish or tray filled with water. The details of construction include sheets of glass, used as directed above, and a little pathway may be provided down which the ants may go to drink. As no ant will willingly pass through water, the inmates are effectually prevented from straying; and the cover of the printing frame keeps out light when the formicarium (as such ant



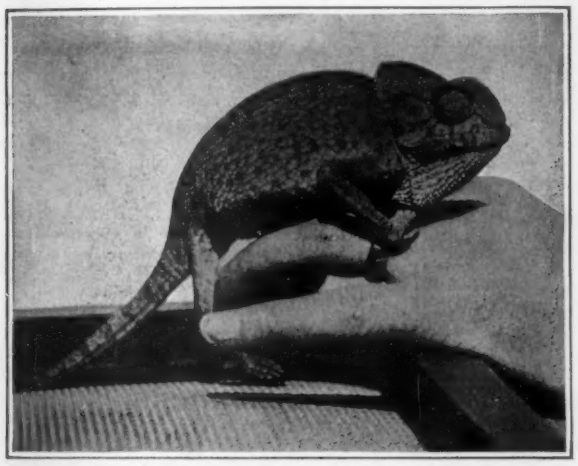
Contrivance for use in making observation tests on ants

Huge West African "Goliath" beetles, not easy to obtain

house is called) is not under any kind of observation.

Next to insects, the smaller kinds of reptiles and amphibians probably make the most interesting pets. Toads respond in a marked manner to kindness. The writer knew of one named Toby which would come when called from the recesses of a flower-pot in which it had made its home. This particular toad, by the way, showed a marked preference for a young gardener, while it appeared to be shy of strangers. Frogs, too, make good pets, especially the various species known collectively as "tree frogs." Many of these have suckers at the ends of their toes which enable them to cling to the smoothest surfaces. They will climb up the window-pane, for example, with the greatest ease, or leap upon the slippery side of a vase. If unmolested, they will remain motionless for hours in one position in the hope of snapping up a meal in the shape of a passing fly. They possess insatiable appetites, and one might easily dispense with fly-paper in a room by keeping two or three of these little fellows in a cage on the table. Like all frogs, however, they are very dependent upon moisture, and must always have a saucer of water within reach.

The various kinds of small lizards are also easy to tame. Many of them make charming pets. This is above all true of the chameleons, which may generally be purchased from dealers in such things at a small outlay. Dispite its somewhat alarming aspect, the chameleon is quite harmless, and may be taken in the hand at any time. It will soon become tame, and may be held up to the window, when it will dart out its long sticky tongue and catch the flies buzzing about on the glass. The eyes of these reptiles are most remarkable. They are devised on a kind of "ball and socket" principle, and can be moved independently of each other. Moreover, as everyone knows, the creature is vested with the most wonderful power of adapting its colors to its environment. The worst point about the chameleon as a pet is that it is very readily killed by a fall in temperature. Yet it can be kept alive through the winter in a warm room. When flies are no longer obtainable it must be fed upon small cockroaches or other insects.

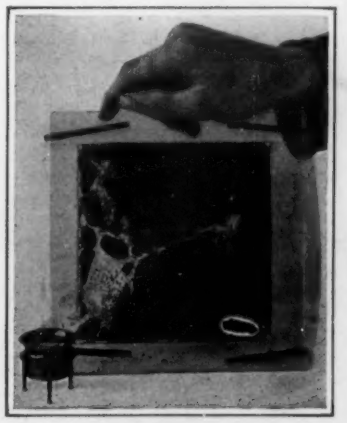


Chameleons make interesting pets. They must be kept warm

Tree frogs posing to catch flies

All toads make good pets, and are easily tamed

An "observation" bee hive. Bees enter and leave through a tube



Nest of captive ants between glass sheets

Mantes, or rearhorses have quaint and pugnacious habits

Speeding Up the Hen

By Leigh Danen

WITH recent news from the West that before long contracts closed by foreign buyers would probably send the price of fresh eggs to a dollar a dozen, and information from London that American eggs are being consumed by the market there at the rate of about ten million a week, special interest attaches itself to a new method of speeding up the year 'round activity of the hen family. Moreover, the American public for some time past has been demanding an increasingly large supply of fresh laid eggs in winter, despite the fact that hens have persisted in producing their maximum supply of the precious articles during the warm months and taking a vacation the rest of the time.

Necessity, always the mother of invention, convinced science that it was time for her to come to the assistance of the hen—and the public. This she has done, with the result that now flocks can be raised along scientific lines so that they will provide a regular and greatly increased supply of eggs at all seasons of the year. Prof. Harry R. Lewis, of the Department of Poultry Husbandry of the New Jersey Agricultural Experiment Station, banded together the forces of science to solve this pressing economic problem and now is passing on to poultrymen the knowledge of how to manage their flocks so that the egg supply will not materially decrease during the cold months, and will retain a high level throughout the other seasons.

Thorough investigations conducted by Professor Lewis at New Brunswick, convinced him that temperature is one of the controlling factors in egg production. During the winter months the average bird lays but few eggs. With the advent of spring, the natural breeding season, the egg production begins to increase; during March, April and May it attains its maximum. The problem therefore was how to obtain the greatest quantity of eggs during November, December, January and February.

Knowing that hens take a vacation in the fall when they rest up preparatory to another season of laying, Professor Lewis decided that there was no use trying to revolutionize their mode of life. Instead, he turned his attention to the pullets. Most poultrymen, he discovered, were hatching only in the natural breeding season, that is during April, May and June. Such birds did nothing but eat and grow during the winter months, which was just the period when their eggs would have been in greatest demand. But a few birds were hatched in March, maturing in early spring. They furnished a clue to the investigators. If a few were hatched, why could not a greater number be brought out, not only in March, but better still in February.

Experiments along this line were started by Professor Lewis, covering a period of several years. The results have proved to the satisfaction of the New Jersey Agricultural Station that chicks hatched about the middle of February will start laying toward the end of July, just at the time when the older hens are getting tired, and will continue their productivity throughout the otherwise eggless months until other and older birds take up the task again.

The early fall weeks previously brought the year to a close on the average poultry farm. But, this no longer need be the case judging from the successful experiment conducted in New Jersey. February pullets can be made to serve as the necessary link in keeping constant the egg production of the flock. The February and March pullets develop rapidly during the summer and reach their laying maturity in August or September. Moreover these early hatched birds have shown themselves to be invaluable in helping the flocks of breeders during the following spring in the production of hatching eggs. Their eggs run extremely high in fertility, producing chicks of hardy, vigorous constitution.

In the course of the experiments, the early hatched birds were brought in from the ranges and placed in the laying houses in August. It was found best to let the pullets mature and finish their development in the houses. They also were kept indoors throughout their laying season. It was learned that, if allowed to remain on the ranges, they did not develop to the best advantage. They were usually brought in three weeks before it was expected that they would do much in the line of egg production. These birds, as most all others, were found to be very much creatures of habit and noticeably affected by changes of environment. That was the main reason for getting them settled before they began laying.

It all seems very simple and it is natural to wonder why no one thought of speeding up the egg supply in this way before. But prior to it being attempted a vast amount of scientific investigation had to be carried on in order to prove its feasibility. Even now many poultrymen are far from convinced that it will work out to their advantage. To overcome this attitude Professor Lewis and his assistants are doing no end of missionary work among the farmers of various states.

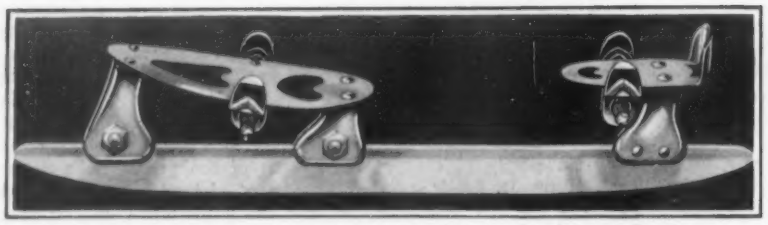
Before the advent of incubators, hens hatched their eggs in regular season, year after year. Poultrymen thought that eggs would not hatch well at other times because of natural conditions. Accordingly, when artificial means of bringing out chicks came into general practice, the routine so long established by precedent was followed. Indeed, the farmers believed that since market eggs sell for such high prices during the winter, it would be unprofitable to hatch any number of them during February, and even more firmly they held to the view that fertility was apt to run lower in chicks hatched during the winter.

But Professor Lewis has routed the theory or superstition which clung around the question of fertility. He has established on a sound scientific basis that farmers should plan to have from one third to one quarter of their chicks hatched during February. In addition he has proved that by early hatching it is possible to get a greater supply of hatching eggs during the following spring from the February-hatched birds, for such birds make the best possible breeders by the next April. Accordingly, February hatchings on a chicken farm result in greater efficiency in fertility and egg supply. The New Jersey investigators are convinced that when eggs are to be the main consideration, poultrymen should pick out strong, vigorous birds for breeders.

An Adjustable Ice-Skate that Grows with the Foot

WHAT is considered a great improvement over the old-style non-adjustable ice skates has recently made its appearance in the form of an adjustable skate that veritably grows with the foot. In other words, the new skate can be immediately adjusted to any sized shoe.

It will be noted by studying the accompanying illustration that the new skate consists of a runner member on which is mounted the usual heel and toe plates; but while the latter is permanently riveted in place, the toe plate is so clamped that it may be moved back and forth along the runner by simply loosening two nuts. Thus it is possible to give the skater a skate that will fit the shoe perfectly and that will stay on his shoe. When in the proper position to fit the shoe exactly, the toe plate is rigidly clamped on the runner by tightening the nuts.



By merely loosening two nuts, the toe plate of this skate can be moved so as to fit any shoe

A Life-Saving Appliance for Those Who Skate on Thin Ice

WITH a view to facilitating the rescue of as many as possible of the thousands of persons each year who fall through the ice, some quite accidentally and others because of their venturesome natures, George Hanlon, foreman of parks in the Department of Parks of the Borough of Queens, New York City, has devised an ingenious life-saving equipment.

The new apparatus permits a helping hand to be extended to the person in distress, without undue danger to the rescuers. It consists of a sled with uprights supporting a jointed, swinging ladder. The sled can be run along the ice to any dangerous spot, where the ladder is pushed out toward the person in difficulty while the rescuers remain on comparatively safe ice. The shorter, swinging ladder at the end of the long, horizontal ladder is then dropped in the hole in the ice, so that the unfortunate one may climb to safety. In the event of the drowning person being too weak to help himself, a rescuer can climb along the ladder to the rescue, and for this purpose a grappling hook is also part of the outfit, together with a coil of rope.

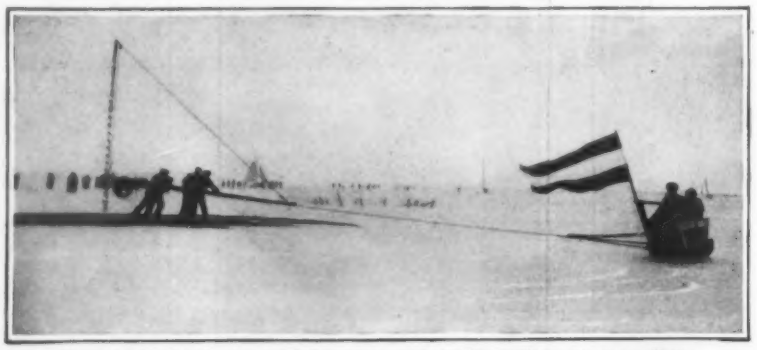
Consisting of a jointed, swinging ladder mounted on a sled, this device has proved effective as a life-saving appliance for careless skaters

Winter Sports of the Russians and the Dutch

DIFFERENT peoples find amusement in different ways during winter months, and despite the war that is raging in Europe it appears that both the peaceful and belligerent countries have found time to indulge in sports on the ice.

The frozen waterways of Holland have found the Dutch given to much outdoor recreation. Typical of their sport is the accompanying view of a sledge-mill on the body of water between the island of Marken and the Continent, in which a crude, wooden sledge is whirled around in a circle by the efforts of four men who are pushing the boom member of the derrick-like device in the center.

Evidently the Russian troops in France have borrowed the idea of the ice carousel from the Dutch, for in another view they are seen using a primitive sledge whirled in a circle by a number of stalwart Russians standing in the center and wielding the rough sapling fastened to the sledge. These troopers, who have seen much active fighting in the Champagne sector, are passing odd moments in sport on a frozen canal in back of the lines. But unlike the Dutch they have added a distinctly warlike touch to their recreation by shooting at a hat thrown high in the air, which is part of the game. Keen competition among the soldiers as to their marksmanship instills plenty of enthusiasm in the sport, and gives them a little relaxation from the usual grim business of fighting.



How the Hollanders spend the winter: A sledge-mill on the ice off the island of Marken

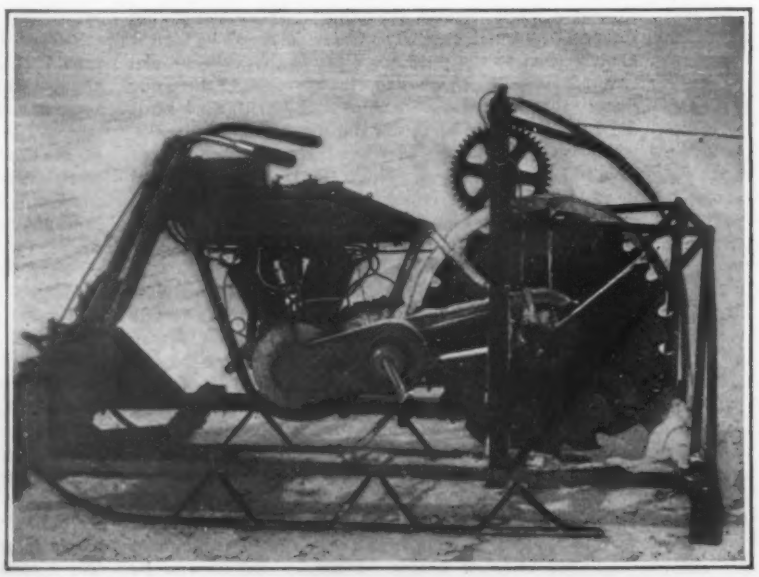
Russian troops in France indulging in rifle practice from a whirling sledge

Illuminated Rifle Sights

MOVED by the earnest desire of the belligerents to continue into the dark hours of the night the kindly process of potting their fellow-men across the way, inventors continue to strive for some method of laying the infantry rifle on an objective when the sun is far below the horizon. These well meant attempts range from the electric flashlight below the bore of the gun, to sights made of some sort of luminous material yclept radium but probably born phosphorus.

While the field gun and the machine gun, both having fixed mounts, can be laid cleverly and efficiently at night by either being set before darkness or by using close at hand and predetermined aiming marks that coincide with the far-off things they want to hit, the infantry rifle has no such easy time of it. Two things are essential, illumination on the objective, and illumination on the front sight if the light on the objects is not strong enough to throw the front sight clearly into silhouette.

The latest variation of the hopeful designs for doing away with one's fellowmen by the shades of darkness. is a pair of little chambers containing radiferous substances and covered with lenses, arranged on either side of the back-sight. A third such chamber is arranged at the front-sight. Apparently all that remains is to attach one or more to the German or Austrian soldier, for whom this kindly sight arrangement was worked out by its French inventor.



This ice-cutter, equipped with a motorcycle power plant, has been tried on the Hudson River, N. Y.

A New Celluloid Cement

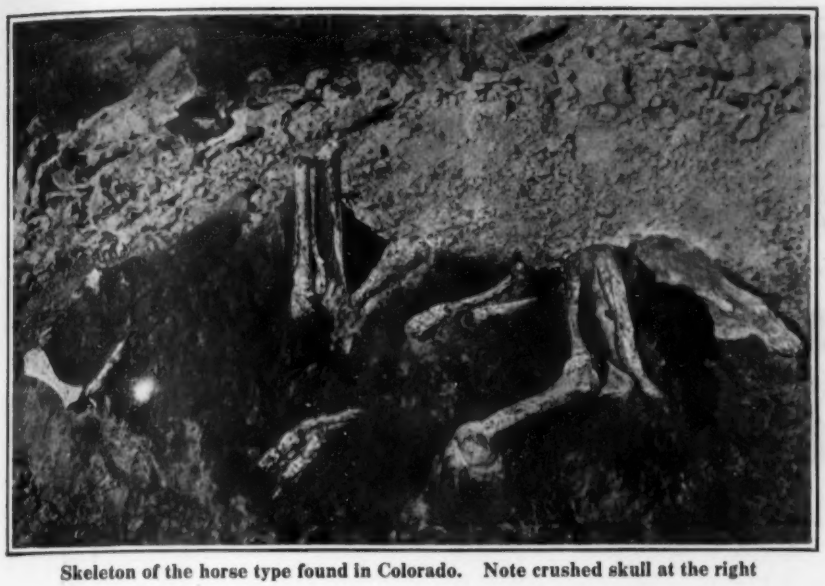
A SWISS contemporary publishes a very interesting account of a new and valuable celluloid cement for gluing leather splits together, so as to form solid slabs or plates of leather. As is well known celluloid solutions possess the drawback of being much too sticky. If a celluloid solution be prepared in acetone or other solvent, it is impossible to obtain a substance of sufficient liquidity, with more than 16 to 18 parts by weight per 100 parts of acetone; if the proportion of celluloid be increased the resulting liquid will not penetrate between the fibers of the material and the parts will not adhere.

In order to secure a highly liquid solution, containing a greater percentage of celluloid, the following process must be observed. Chemically or technically pure acetone (100 parts) celluloid (20 to 30 parts), and oxalic acid (not more than 2 parts), are placed in an iron receptacle. After hermetically closing the receptacle, the ingredients therein are thoroughly mixed, by suitable stirring gear, at a normal temperature; this is continued, either incessantly or at intervals, for a period of 12 to 14 hours. The product obtained can be used at once, or kept for an indefinite period in the hermetically closed receptacle. This adhesive must correspond to the absorptive capacity of the material. If too thin it must be suitably thickened; pressure can also be used to force it into the material if necessary. It is insolvable in water, and is highly valuable for fastening leather; it will be of special use in driving belt factories.

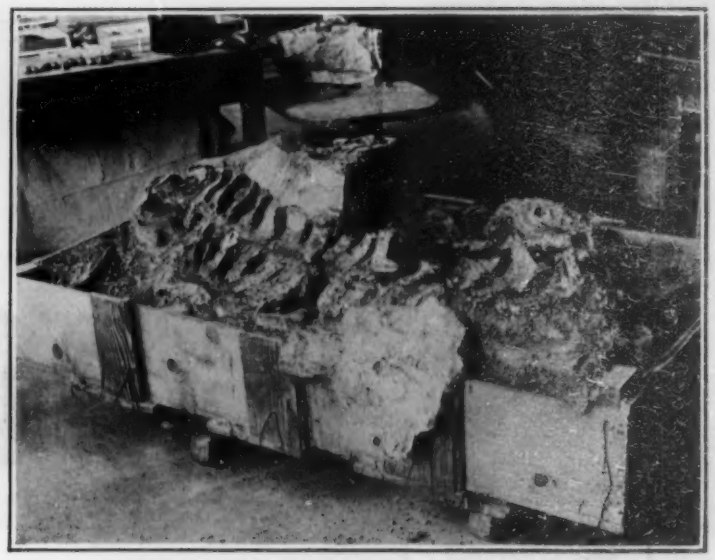
The Motorcycle in the Role of Ice-Cutting Machine

ONE of the very latest applications of the versatile motorcycle is in the field of ice harvesting; and a short while ago a novel contrivance in the form of a remodelled motorcycle was being experimented with in the ice fields of the Hudson River, N. Y.

The motorcycle ice-cutter can be briefly described as a motorcycle with its wheels removed, mounted on a light framework of a light-runner sleigh, and driving a buzz saw which is placed at the rear of the machine. Obviously, the power of the engine is used to drive the buzz saw, and the usual system of control is employed; but the operator after starting the engine with the pedals, takes his position in back of the equipment. To prevent the ice-cutter from moving forward during cutting operations, a block, mounted at the base of the rear framework, is brought to bear on the ice. By means of a crank which operates a windlass through a chain of gears, the saw, rapidly rotating all the while, is lowered down into the cutting position. To move the ice cutter to the next location the rear block is slightly raised, whereupon the machine moves forward.



Skeleton of the horse type found in Colorado. Note crushed skull at the right



A consignment of dinosaur bones arriving at the museum

Bandaging Bones

IMPROVED methods of preserving vertebrate fossils found embedded in rock and earth are now practiced by men who secure specimens of pre-historic animals. Formerly such bones were cut out of their resting places and cemented together with glue which only holds them temporarily. Fitting together such a mass of pieces in laboratories was an impossibility, and as a consequence many valuable skeletons have been lost to science, because the bones could not be reassembled. Many months and sometimes years elapse between the time of finding a fossil and its final exhibition in a museum.

A system of preserving the bones as found in the field is now employed which consists of bandaging them with burlap soaked in raw flour paste. This material is wrapped around bones, rock and dirt, and sometimes reinforced with wooden supports. The bones are thus securely fastened to the material in which they are embedded. When thus treated, labeled, and made fast, the bones are boxed and shipped to the laboratories.

The preparation and mounting of bones to make a permanent exhibit requires much time, as well as the utmost skill and care while doing the work. A wet sponge applied to the bandages loosens the paste and burlap, and as the rock and earth are dug away with small tools, shellac is applied to broken and crumbly pieces to hold the parts together while the bones are being separated.

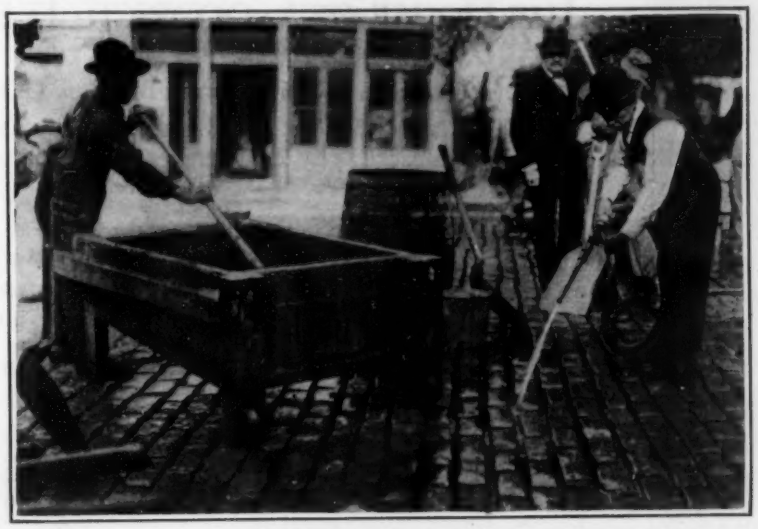
In exhibits as finally constructed bones are fastened together with iron rods or wire. Many small tools are employed for doing the various kinds of work in laboratories, some being electrically operated. Carborundum wheels, drills, dental lathes, dental burs, rotary brushes and diamond saws form part of the equipment in laboratories; and overhead trolleys are employed for moving the heavy skeletons about.

The City of Non-Skid Streets

CINCINNATI, a city which possesses many miles of worn out granite block pavement in a condition highly discouraging to the use of automobiles, has discovered a way of renovating their thoroughfares at very slight expense. Indeed, the made-over paving possesses the great advantage of being practically skid-proof while at the same time affording proper footing for horses.

The only new material required by this process is a small amount of cement and sand. The old granite blocks are taken up and thoroughly cleaned of all adhering fillers. The worn-out sand bed is removed and wherever necessary the cement foundation is repaired. A new sand bed is laid, using old and new sand indiscriminately, and the blocks are then relaid with about a half-inch space between them.

The relaid paving next receives a thorough flushing with hose; and while it is still wet a mixture of two parts sand to one of cement, with enough water to make it flow readily, is raked and swept into all the interstices. Before this filler dries a finishing coat of sand and cement in equal proportion is spread evenly over the entire surface of the pavement. This surfacing coat makes the street as smooth as newly laid asphalt; and the longer it stands the harder it gets. Four days are allowed for firm setting before the street is opened to traffic.



Flushing the relaid granite blocks preparatory to putting down the cement grouting

Experience is that the cement grouting never chips from the granite, but actually becomes better with continued traffic. It affords a non-slippery surface in winter and in wet weather alike. The smoothest tire will hardly skid on it, and unlike brick and wood block pavings it does not cause horses to slip.

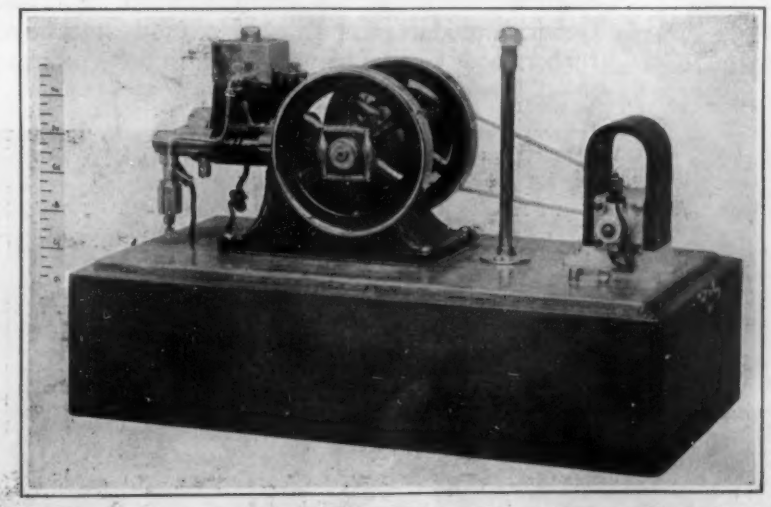
Streets which were resurfaced five years ago are in as good condition to-day as when just completed. As fast as the granite pavements need repairing they are being resurfaced by this method, until Cincinnati is fast becoming the city of non-skid streets.

With the club-barrel a policeman can convert his revolver into a rifle, gaining a big advantage over an adversary armed with the ordinary revolver

A Policeman's Club That Converts a Revolver Into a Rifle

MAKING the policeman's club do duty as the barrel of a rifle the basis of which is the conventional revolver, the latest invention of Frank Barnet, sheriff of Alameda County, California, can unhesitatingly be termed a novel one.

Sheriff Barnet makes use of the ordinary hardwood police club through which he bores a hole lengthwise through its center, inserts a rifle barrel, and at the end of the handle introduces an ingenious locking device for securing the extension barrel to the muzzle of the revolver. The combination can be effected in a second, and the improvised rifle thus obtained is said to give the officer a considerable advantage over any enemy, mainly because of the greater accuracy in aiming. The extension barrel-club is 14 inches in length and an inch and a half in diameter.



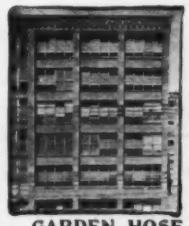
For the purpose of charging small accumulators, this miniature gasoline engine has been built by high school boys

A Baby Gasoline Engine

RECENTLY it was desired to secure a small engine to be used for charging miniature accumulators made and used by pupils of the Applied Science Department of the Washington Junior High School in Rochester, N. Y. Unable to find on the market just what was needed, one of the instructors set about its construction. He was informed by a prominent engine designer that it was not possible to build a properly working four-cycle engine with a bore smaller than 1½ inches. But he refused to accept this opinion, and proceeded to prove that it was wrong by building the engine which we illustrate herewith.

This is by all means one of the smallest gasoline engines ever constructed. It is 5 inches high, 4¾ inches long from end to end, and 3½ inches wide across the flywheels. It is of the 4-cycle, stationary, water-cooled type. The cylinders are ¾-inch bore, water jacketed, with hopper

(Concluded on page 314)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FIRST in the development field by seniority, Goodrich has always KEPT FIRST by learning new ways of the earth's great material mystery — RUBBER — to fulfill the needs of mankind, often *anticipating* the needs.

It was no coincidence that Goodrich made the FIRST clincher automobile tire in America, the FIRST *cord tire*, and the FIRST solid rubber tire for automobile trucks, buggies and carriages. As Goodrich's business is rubber, its organization has always automatically met the NEWEST need of rubber.

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It is a creed which backs up a *Goodrich rubber* band with *the same* jealous watchfulness of the Goodrich reputation as a Goodrich tire.

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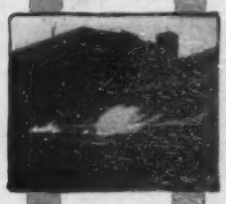
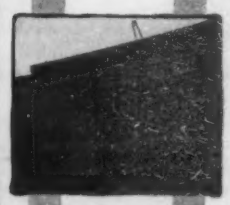


STRAIGHTLINE RUBBERS

INSULATED WIRE

MILLING AND CALENDERING

LABORATORY AND TESTING



FIRE AND MILL HOSE

ADMINISTRATION BICYCLE TIRES MOTORCYCLE TIRES CARRIAGE TIRES INNER TUBES

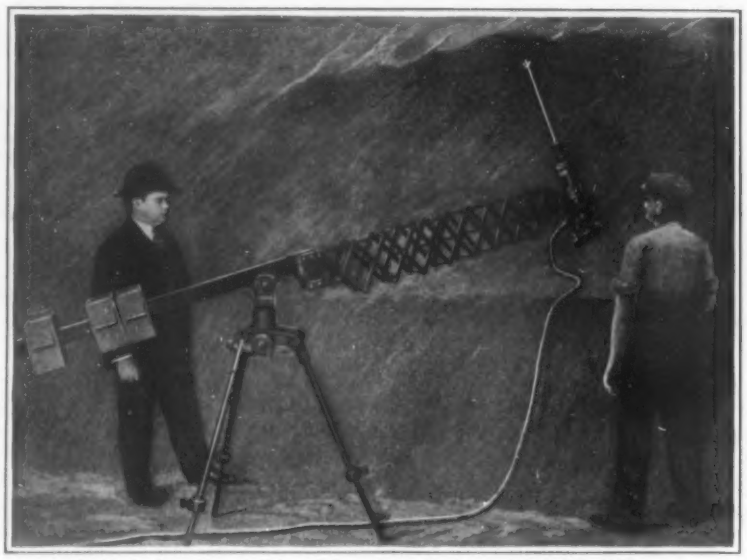
Inventions New and Interesting

A Department Devoted to Pioneer Work in the Arts

Tools on Stilts

THE use of pneumatic riveters, chippers, bushers, drills, tamping tools, electric grinders, small power hammers, and the various other models of portable power-driven tools is greatly handicapped by the necessity of holding the tool in place by hand. No one who has ever seen a workman struggling with such a tool can doubt the accuracy of the statement made in this connection that human strength and endurance are not equal to the task of holding these machines to an average of more than 20 per cent efficiency.

On the other hand, it has heretofore not been found possible to design a supporting brace or rack or stand which would not seriously interfere with the tool's portability. The answer, however, has been found, at least in part, by a Chicago designer, who has introduced the device which we illustrate. While this lazy-tongs construction does not ordinarily embody much rigidity, there seems no valid reason why it cannot be made to do so, and we are assured that in this instance it leaves little to be desired. The counter-weights achieve their end more by virtue of leverage than of extreme weight, so that the entire weight of the holder with tool is not excessive.



Flexible support of lazy-tongs type for heavy portable tools

Theoretically the tools used in connection with this holder should develop a hundred per cent efficiency. The workman is entirely relieved of the weight and shock of the tool, and his whole energy may be directed to guiding it. When the arm is fully extended the tool has a range of 16 feet, making frequent shifting of base unnecessary. Tools weighing as much as 150 pounds can be used to advantage with this holder, which is constructed to withstand the most severe usage. It may be mounted either on tripod or adjustable truck.

The Laboratory Oscillion—A Generator of High-Frequency Currents

LONG-DISTANCE telephony, long-distance radio-telephony, and long-distance radio-telegraphy are a few of the accomplishments that owe their realization largely to the audion-amplifier, audion-ultraudion, and the oscillion transmitter invented by Dr. Lee DeForest, of New York. So it is with some interest that the appearance of a laboratory oscillion or oscillating audion, is noted, since it is now possible to apply this apparatus to so many different experiments.

The new laboratory oscillion has been especially designed for schools, colleges, technical institutes, scientific laboratories, research laboratories, universities, and wherever measurements and measuring instruments are employed. It affords a wide field in measuring capacities, frequencies, inductances, wave-lengths, etc. It is a generator of pure sine wave high-frequency oscillations, the frequency of which depends on the wave-length employed. The oscillion may be used for the transmission of radio telephone and radio telegraph signals over short ranges.

By using the oscillion one is enabled to do extensive research and calibrating work on all types of radio frequency circuits and instruments; furthermore, it may be used for "heterodyne," beat and interference experiments. The oscillion generator produces results which are claimed to be incomparably superior to those possible with any buzzer, impact or arc type of excitation, since the pure sine wave current is constant in amplitude. For example, a difference of a few cms. inductance or capacity can be quickly determined merely by associating one or two resonant circuits with the oscillion circuit, connecting a detector and telephone receivers to one of these circuits and tuning until a certain definite "beat note" is heard, say one of 300 per second. Then vary the inductance, say of two short parallel wires, until the wave frequency is altered by about 20 periods per second.

This apparatus, known as the oscillion, generates high-frequency currents for laboratory and experimental purposes

(Determine these frequencies by comparison with a tuning fork, etc.) After having determined the wave length by means of a wave meter, the number of oscillations which caused the change in frequency of "beat note" is known. Then if either capacity or inductance of the full circuit is known, the minute change in capacity or inductance which caused the change in the "beat note" can be determined. This is but one application of the oscillion, and many other similar applications of the oscillion generator to quantitative work will suggest themselves.

Delivering Anesthetics by Machine

VARIOUS elements of danger in operations are lessened by the device of a Los Angeles surgeon, Dr. Edward Kellogg, who has put his invention at the service of the profession. The apparatus consists of a small electric motor, a small pump which applies air pressure and also operates a suction device, two glass containers, an electric heating device at the base of one of the containers, and the necessary rubber tubing, electric wiring, stand, etc.

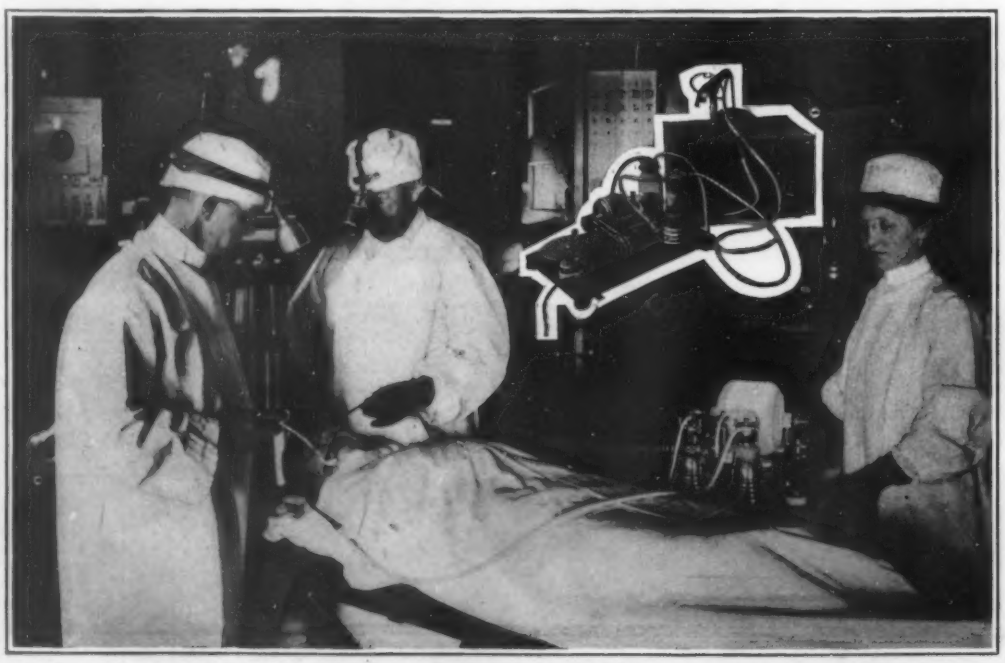
The purpose of this invention is to deliver ether to the patient in the form of a *heated* vapor through a tube which is brought to the base of the tongue. This has two advantages: The anesthetic is delivered steadily and constantly throughout the course of the operation and there is no danger of a patient regaining consciousness at a critical period, which would necessitate the halting of the operation while more ether is applied. The use of the cone is dispensed with; the container for the ether is set in a base that contains an electrical heater, and the vapor is warmed before entering the patient's lungs. The heating of the vaporized ether is of the greatest importance, as it is well known that the chilling of the lungs from the cold ether is a source of danger that may result in pneumonia. The effect upon a patient with weak lungs may be very serious and even fatal.

While the apparatus is delivering anesthetic through air-pressure applied to the ether container, a vacuum is formed in the second glass receptacle. This connects with a rubber tube held by the surgeon's assistant, and is used to drain off the blood as the operation proceeds. Instead of making use of sponges and continually swabbing at the incision, the assistant merely passes the end of the suction tube about the wound, and keeps it free from blood without interruption. It is passed through the tube and delivered to the glass container. Any person who has witnessed an operation will realize the vast importance of the device which enables the surgeon to see clearly what he is doing, and allows him to continue operating without any pause for swabbing the incision with a sponge.

Dr. Kellogg, who is one of the most eminent surgeons of the West, developed this apparatus in two forms, one of which is portable and may be carried in a medium sized case. After making use of this for a year, he perfected a larger and more complete device for hospital use, which has been utilized in hundreds of operations with uniform success. Instead of capitalizing his invention, he has followed the ethics of his profession by allowing it to be used freely by other surgeons, preferring the advancement of science to his own personal profit.

The photographs show the portable device, and the larger, hospital apparatus in use during an operation in the throat.

Another apparatus for the automatic delivery of ether, known as the etherometer, was fully described in the SCIENTIFIC AMERICAN some time ago. However the etherometer was hand-operated and delivered cold ether.



An operating room scene, showing a newly devised apparatus for administrating anesthetic, in use
A portable type is shown in the insert

A Baby Gasoline Engine

(*Concluded from page 309*)

above holding enough water to keep the engine cool at all speeds. The piston is made of cold rolled steel and is fitted with three leak-proof rings. The T-head, which is detachable, contains both the inlet and exhaust valves. The diameter of the valves is $\frac{5}{16}$ inch and the valve opening is approximately $\frac{7}{32}$ inch.

The carbureter is of the float feed type with automatic air adjustment and also a primary adjustment. The float chamber is $\frac{1}{2}$ inch in diameter, with cork float $\frac{3}{8}$ inch in diameter and needle valve. The carbureter is entirely automatic and a perfect mixture is obtained at all speeds.

The gasoline tank holds 2/231 gallon or approximately three tablespoonfuls, and the engine will run for three hours with one filling of the tank. The feed pipe from tank to carbureter is $\frac{1}{16}$ inch seamless tubing.

The engine is of the high-tension ignition type and operates from dry cells and spark coil located in the box underneath the engine. The spark plug is $\frac{3}{4}$ inch long and the porcelain is $\frac{5}{16}$ inch in diameter. It was constructed of a large spark plug ground down to the required size.

Stationary engines are ordinarily not equipped with a timer, but in this model a timer has been incorporated so that the spark may be advanced and the engine run at a maximum speed of 4,000 revolutions per minute. At this high speed the engine runs with perfect smoothness and without skipping a single explosion. The engine is equipped with an automatic centrifugal governor which controls the speed of the engine under varying loads and with the engine running free limits the speed to 1,500 revolutions per minute.

The lubrication system comprises two small grease cups $\frac{1}{4}$ inch in diameter supplying the main bearings, and a sight-feed oil cup for the engine, $\frac{1}{2}$ inch in diameter and $\frac{3}{8}$ inch in length. The glass for the oil cup was made from a small pill vial. The oil in this cup will lubricate the engine for ten hours of continuous running. The most difficult problem to be solved in the construction of this engine was in regulating the oil supply for the engine. One drop too much on the piston would increase the suction to such an extent that the gasoline mixture was changed and the engine would not run smoothly. After much experimenting this difficulty was entirely obviated.

The small amount of oil which drips from the engine is collected in a small copper tank underneath the engine. This surplus oil can be drawn off and used again.

The crank shaft is $\frac{1}{16}$ inch in diameter and this as well as all other moving parts is made of steel, hardened. The engine has bronze bearings throughout.

The muffler is placed beneath the explosion chamber. It is $\frac{1}{4}$ inch in diameter and $\frac{1}{2}$ inch long, constructed of brass tubing, one member telescoping the other. The inner tube is filled with fine wire gauze. The exhaust pipe is equipped with a muffler cut out.

The magneto is of three-volt capacity, alternating current type. With the engine running at 1,500 revolutions per minute the magneto operates at 4,500 revolutions per minute and it furnishes current for the incandescent lamp placed between the engine and the magneto.

The engine is approximately of $\frac{1}{8}$ horsepower and its efficiency is shown in driving a 6-volt, 4-ampere generator at 3,500 revolutions per minute.

Tin Plate and the Cost of Living

A FAR from negligible factor in the high cost of living is the price of tin plate, with its effect upon the cost of all canned goods. With the Welsh tin production seriously cramped by the war, American exports of the finished plate have increased notably. In 1916 the total was 226,944 gross tons, against 57,812 tons for 1913, itself a record year in this respect. We are undoubtedly sending abroad 25 or 30 per cent of our output of this staple, so our canners have to pay proportionately more for their supply, and this is reflected in the price of their goods.

Germination of French Seeds

Much has been written lately on the subject of the rect period in seeds, and especially on the capacity of seeds of certain species to germinate without any rest period. The *American Botanist*, in reviewing the latter phase of the subject, states that in the case of the tomato seeds will sprout even when taken from green fruit. Beans often sprout in the pod if the late summer happens to be moist. The mangrove is remarkable for the fact that its seeds develop into young plants before separating from the parent plant. The same phenomenon occurs, on a less marked scale, in some of the oaks.

Gasoline from a New Source

A NEW source of gasoline has been found. The United States Geological Survey for over three years has been conducting investigations as to the possibility of a commercially profitable utilization of the enormous supplies of petroleum to be derived from the distillation of the vast deposits of so-called hydrocarbon shales of the Green River formation of northwestern Colorado and northeastern Utah. Very rough but cautious calculations of the contents of the shales in parts of this area indicate that the distillation of shale from beds over 3 feet thick in Colorado alone will yield more than 20,000,000,000 barrels of crude oil from which more than 2,000,000,000 barrels of gasoline can be extracted by ordinary methods.

The Gear Drive in Ships of Large Power

Concluded from page 303)

stresses due to the increased torque—a matter of straight-forward mechanical design. If this were done, we fail to see any possible reason why the one outfit should not run with the same low frictional loss (2 per cent) and the same reliability as the other.

Before closing the present article, we wish to reiterate that the SCIENTIFIC AMERICAN has no more interest in the geared drive than the electric drive, except so far as we wish to see that form of drive employed which will permit of the whole of the motive power being placed below the water-line and beneath the shelter of the protective deck.

If Admiral Griffin is prepared to stake the vital interests of the Navy, to say nothing of his own professional reputation, upon his conviction that a jump from 7,000 to 180,000 horse-power can be made in a marine electrical installation, without involving any unforseen disadvantages due to this vast leap in power, by all means let the electric drive go in, even though it be found necessary, in order to get everything below water, to lengthen the ships from 850 to 925 feet.

If, on the other hand, Admiral Griffin, remembering that he is satisfied to use the geared drive for 90,000 horse-power, should go over the whole question once more with an absolutely unbiased mind, and should come to the conclusion that what is safe for a 90,000 horse-power scout is perfectly safe for a battle-cruiser of twice that power, he will find, we doubt not, that it is possible to put everything below the protective deck without intruding upon the torpedo-defense elements in the ship, and that the result can be accomplished on a vessel of the present length of 850 feet.

Incidentally, he will find that the installation can be made with a saving of 1,000 tons in weight of machinery and a saving of over 1¼ million dollars in each of the six ships. And not only so, but he will realize that by placing the whole of the boiler plant below the protective deck, he will be placing the weight of a dozen boilers, weighing, roughly, 1,000 tons, 16 to 18 feet lower down in the ship. And although he is not a naval constructor, he can doubtless realize that in the event of the ship being torpedoed, this lowering of weight with resultant increase of stability will go far to prevent that "turning turtle" which has occurred in nearly every battleship and cruiser sunk by the torpedo in the present war.

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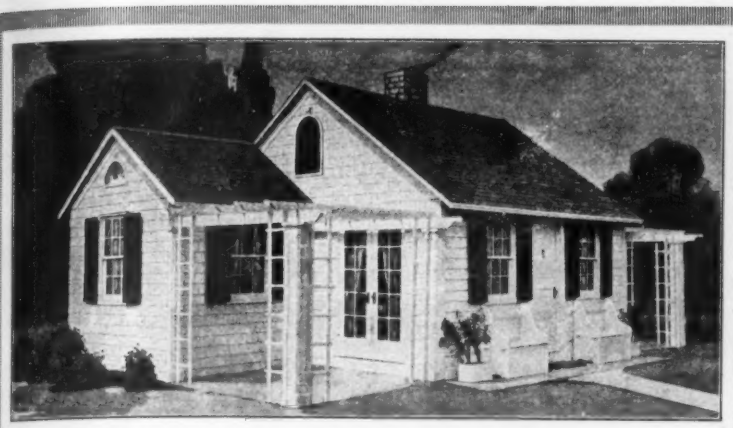
Profitable, inexpensive, perpetually salable, admittedly superior household necessity with large demand. Mail order or jobbing. Cash or light touring car, standard make, part payment. Address "Sale," Box 772, N. Y.



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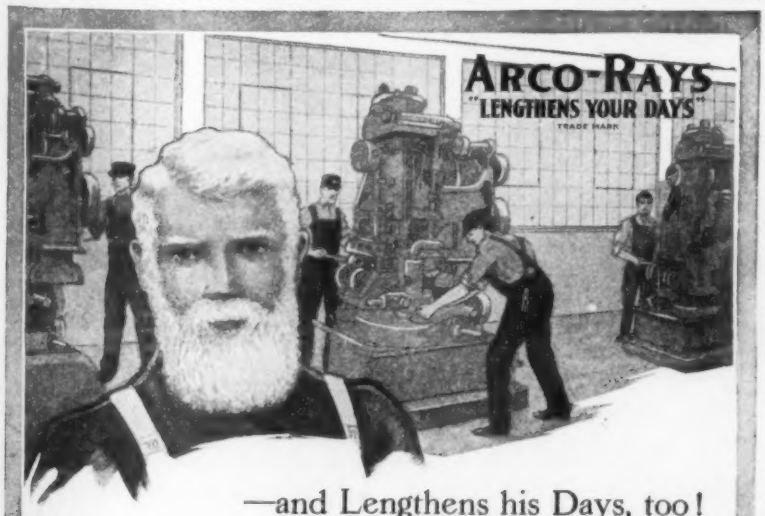


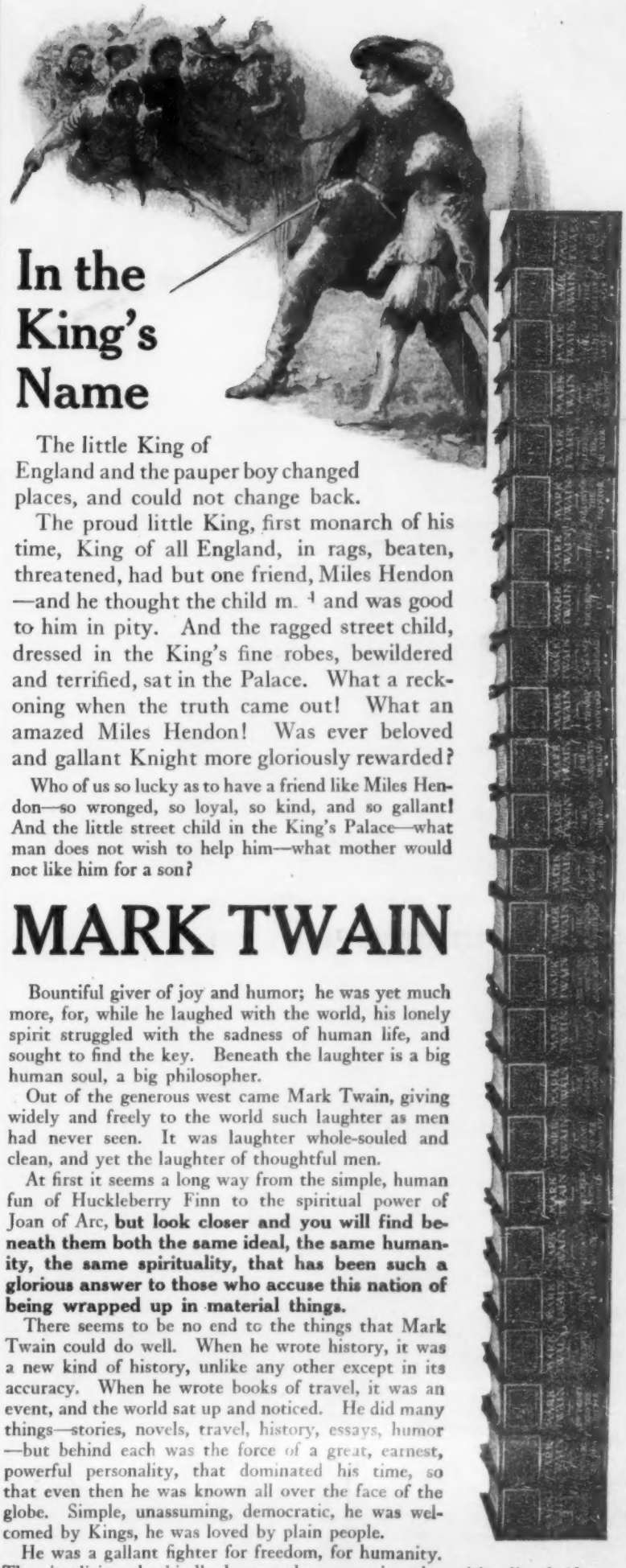
—and Lengthens his Days, too!

NOT ALONE does Arco-Rays "Lengthen Your Days," by creating material savings and benefits, when applied to factory walls, columns and ceilings. Better still, it immediately gives an atmosphere of cheer, safety and comfort to interiors which makes these factories the goal of good workmen. Such bright, clean, sanitary rooms conserve health and eyesight, and long years of uninterrupted endeavor answer the call of employers for the best in their men.

Write us today how to get an Arco-Rayed interior that reflects and diffuses all the light it receives, both natural and artificial, and one that helps hold human efficiency superior to mechanical efficiency.

1143 WISE BUILDING — **THE ARCO COMPANY** Founded 1880 — CLEVELAND OHIO

Paints, Varnishes and Enamels



In the King's Name

The little King of England and the pauper boy changed places, and could not change back.

The proud little King, first monarch of his time, King of all England, in rags, beaten, threatened, had but one friend, Miles Hendon—and he thought the child m. d and was good to him in pity. And the ragged street child, dressed in the King's fine robes, bewildered and terrified, sat in the Palace. What a reckoning when the truth came out! What an amazed Miles Hendon! Was ever beloved and gallant Knight more gloriously rewarded?

Who of us so lucky as to have a friend like Miles Hendon—so wronged, so loyal, so kind, and so gallant! And the little street child in the King's Palace—what man does not wish to help him—what mother would not like him for a son?

MARK TWAIN

Bountiful giver of joy and humor; he was yet much more, for, while he laughed with the world, his lonely spirit struggled with the sadness of human life, and sought to find the key. Beneath the laughter is a big human soul, a big philosopher.

Out of the generous west came Mark Twain, giving widely and freely to the world such laughter as men had never seen. It was laughter whole-souled and clean, and yet the laughter of thoughtful men.

At first it seems a long way from the simple, human fun of Huckleberry Finn to the spiritual power of Joan of Arc, **but look closer and you will find beneath them both the same ideal, the same humanity, the same spirituality, that has been such a glorious answer to those who accuse this nation of being wrapped up in material things.**

There seems to be no end to the things that Mark Twain could do well. When he wrote history, it was a new kind of history, unlike any other except in its accuracy. When he wrote books of travel, it was an event, and the world sat up and noticed. He did many things—stories, novels, travel, history, essays, humor—but behind each was the force of a great, earnest, powerful personality, that dominated his time, so that even then he was known all over the face of the globe. Simple, unassuming, democratic, he was welcomed by Kings, he was loved by plain people.

He was a gallant fighter for freedom, for humanity. The simplicity, the kindly humor, the generosity, the spirituality half revealed, that we like to think is America—all these were in Mark Twain. If foreign nations love him, we in this country give him first place in our hearts. The home without Mark Twain is not an American home.

The Centennial Half-Price Sale Must Close

Mark Twain wanted these books in the hands of all the people. He demanded that we make good-looking, substantial books that every man could afford to own. So we made this set, and there has been a tremendous sale on it.

But Mark Twain could not foresee that the price of paper, the price of ink, the price of cloth, would all go up as they have in the last two years. It is impossible to continue the long sale It should have closed before this.

Because this is the one hundredth anniversary of the founding of Harper & Brothers we have decided to continue this half-price sale while the present supply lasts

Get your set now while the price is low As an American you must have Mark Twain Send the coupon today before the present edition is all gone

HARPER & BROTHERS
Franklin Square (1817-1917) New York

Sci.Am
3-24-17
Harper & Brothers
Franklin Sq., New York

Please send me Mark Twain's Works. I may keep this set for ten days for examination and return it to you, at your expense, if I do not want it. If I keep the books I will remit $1.00 at once and $2.00 a month for 12 months.

Name.....

Address.....

10 per cent. added on Canadian prices because of duty.

Bringing "Mr. Britling" to America

The Great War had come. We had sent to the front a corps of trained writers—Arthur Ruhl, Frederick Palmer, Henry Beech Needham, Perceval Gibbon—who were filling the pages of Collier's with vivid first-hand pictures of War as it is.

And yet—there was something more.

Not the shell-torn terrain, the clash of areoplanes, the mud and squalor of trenches, the trains of wounded. . . .but something more intimate to each of us. The *effect* of this war on the souls of people, people like ourselves, in the quiet towns and countrysides of Europe. How was it changing their feelings toward themselves, toward their fellows, toward government and such things as national honor and prestige, if it was changing them?

Could any writer give *this* to Americans?

Then, we learned that H. G. Wells was writing a novel on the war. We arranged to see the manuscript.

"Mr. Britling Sees It Through," we found, did achieve this thing, marvelously. The placid scene of English life on which the war burst with dramatic suddenness. . . . The questions it flung in the face of complaisant theory. . . .And then—the winning to an answer to these questions. . . .And finally the winning to a conviction of the only basis of a peace that can make future Great Wars impossible. . . . All this not told abstractly but through a brilliant story of real human beings, pivoting round the delightful, endearing, tragic Mr. Britling. (Who can read without deep emotion and who having read can ever forget that scene, for example, where Mr. Britling as a refuge from his anguish at the loss of his son in battle sits by the roadside atlas in hand and draws, in red ink, new frontiers on the map of Europe, frontiers determined by race and language, effacing those made by jealousy and greed?)

So, we brought "Mr. Britling" to America as a Collier serial.

As a Collier serial and now in book form, "Mr. Britling" is the year's sensation, hailed in England and America as the one big imaginative work created by the Great War.

Collier's, in short story and serial, holds to this ideal—*entertainment—yes, and something more.* We cite "Mr. Britling," a recent instance, because Wells' novel is now in the world's eye and so admirably realizes that ideal.

For Collier's believes that a growing body of Americans demand fiction that both enhances life's enjoyment and, in some measure, helps to life's understanding.

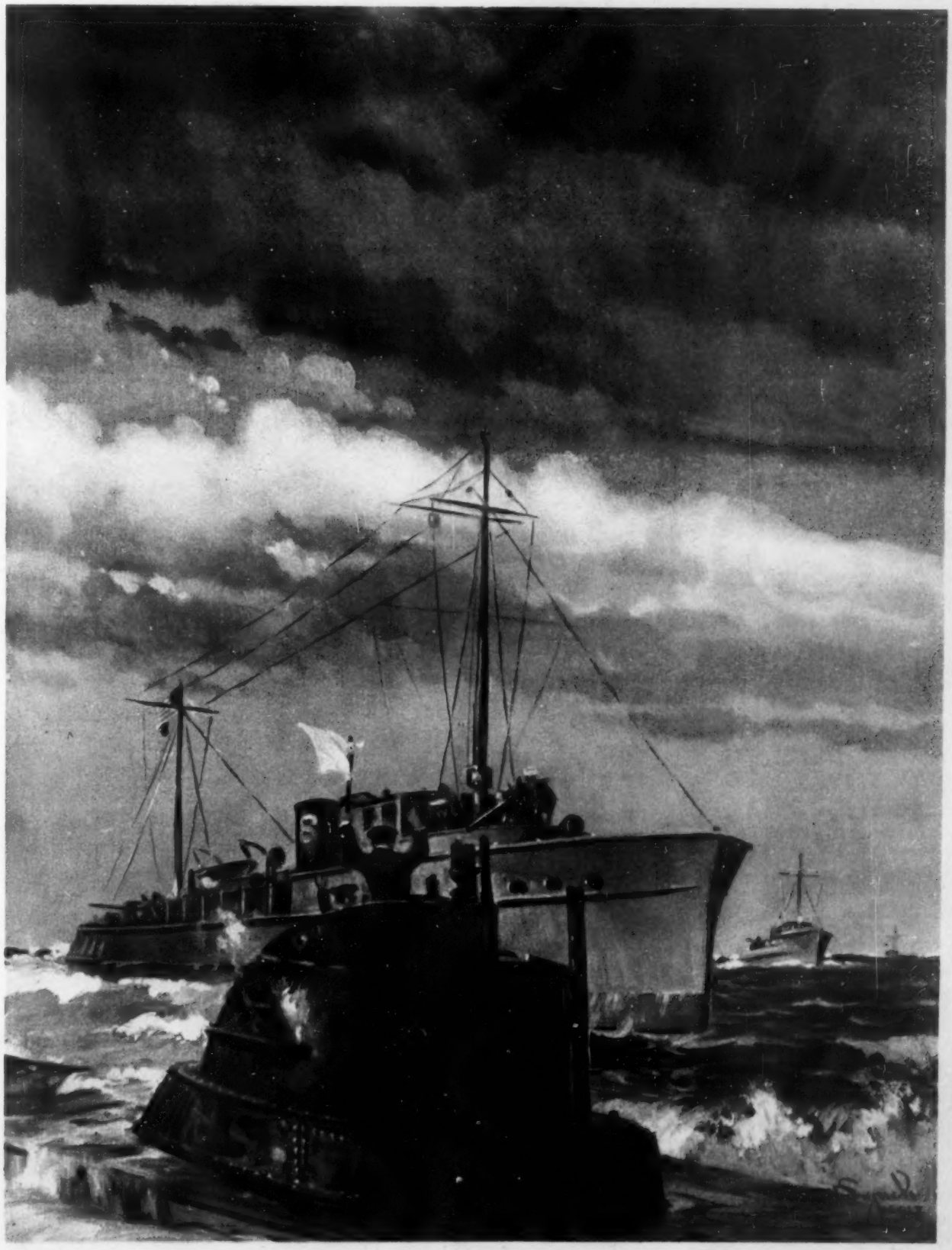
This is one of the ways in which Collier's earns the right to its title "The National Weekly."

This advertisement is the first of a series on the relation of Collier's to the nation

Collier's

THE NATIONAL WEEKLY

SCIENTIFIC AMERICAN



SWIFT MOTOR PATROL BOATS THE TERROR OF THE SUBMARINE—[See page 322]

March 31, 1917

Munn & Co., Inc., Publishers
New York, N. Y.

Price 10 Cents

Prince Albert's quality gives joy that jams coupons right into the discard!

Flashes such flavor and fragrance into your smoke-system so quick and so friendly-*like;* tips you to bang away so heartily via jimmy pipe or makin's cigarettes that you feel you must hire-a-hall and sing-a-song that'll be heard from Boston-to-Bombay!

Prince Albert has won-in-a-walk without offering coupons or premiums. We have preferred to put their *cost into quality!* And, me-o-my, how smokers have come across and backed our judgment! Every P. A.-pal has wised up to his personal smoke-satisfaction that the speedier he opens up his smoke-throttle the better he likes Prince Albert! For, its *quality*-flavor and *quality*-fragrance are right there—and P. A. won't bite or won't parch, no matter how fast you push it! That's because our exclusive patented process *cuts out bite and parch!*

Might just as well prove this say-so *now:*—Every puff of Prince Albert has a quality tag tacked to it! Each fire-up goes you one better than the last! P. A. tunes your smokeappetite so cheery you hit a new excuse to fill 'er up again or roll-a-tube-or-two every little once and a while! *Quality puts such go-to-it-ness into*

PRINCE ALBERT

the national joy smoke

R. J. REYNOLDS TOBACCO CO.
Winston-Salem, N. C.

Prince Albert has brought thousands of men to know the happiness of the pipe-pastime; it has swung many into the ranks-of-the-rollers! *It will win you* on its down-right goodness, due to its quality, if you'll stand-by-for-a-spell and take at 100 per cent what we tell you about P. A., or what smokers all over the civilized world will tell you!

Costs you mighty little to prove our confidence in what Prince Albert certainly can do for your smoke-content. For, the toppy red bag costs but 5c; the tidy red tin, a dime. Or, take a fall out of the handsome pound or half-pound tin humidors—*or*—that clever, practical pound crystal-glass humidor with sponge-moistener top that keeps the tobacco in such perfect condition.

You buy Prince Albert *everywhere*—like you find men in all walks of life smoking it—*everywhere!*